NEW ZEALAND

MINISTRY OF AGRICULTURE AND FISHERIES

FISHERIES TECHNICAL REPORT

No. 151

TUNA INVESTIGATIONS BAY OF PLENTY, NEW ZEALAND 1969 — 1971

A. G. YORK

WELLINGTON, NEW ZEALAND

1977

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A.G. YORK.

FISHERIRES MANAGEMENT DIVISION,
MINISTRY OF AGRICULTURE AND FISHERIES.
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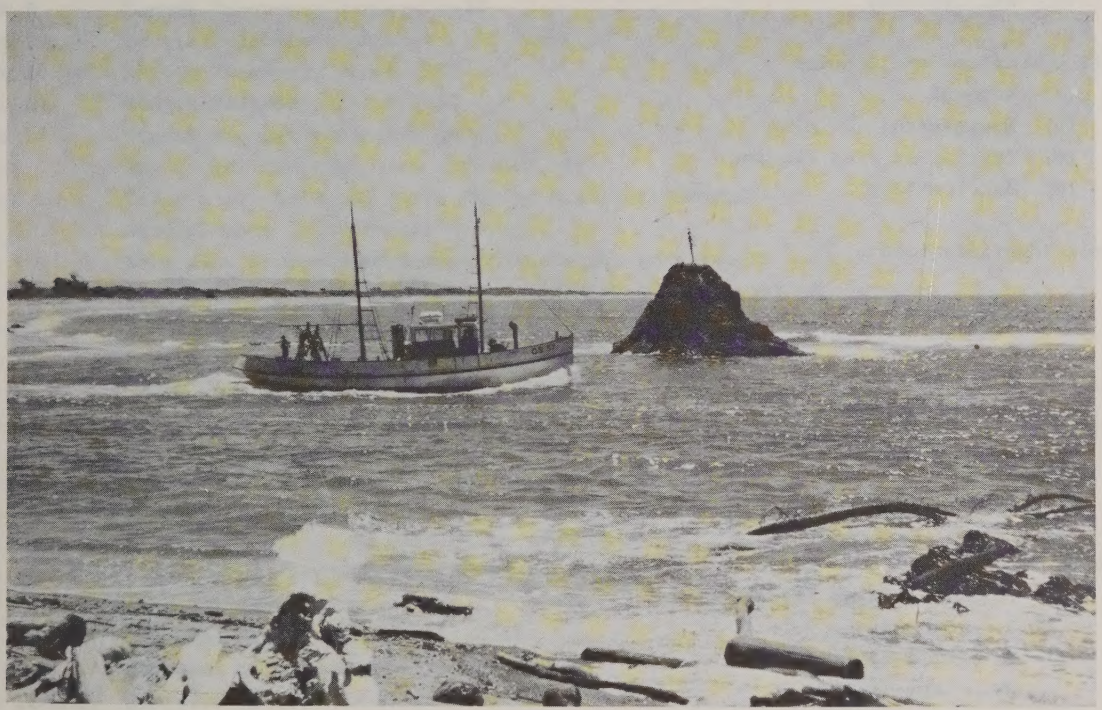

PLATE 1. F.V. "TRADE-WIND" LEAVING WHAKATANE HARBOUR.

CONTENTS

	Page
Introduction	1
Equipment and Methods	1
(a) Vessels	1
(b) Navigation	2
(c) Fish Finders	2
(d) Acoustic Equipment	2
(e) Data Recording	2
(f) Hydrology	2
(g) Fishing Equipment	2
(h) Sub-Population Studies	6
(i) Air Spotting	6
Field Operations and Results	20
(a) General	20
(b) Navigation	20
(c) Instrument Fish Finding	20
(d) Air Spotting	26
School Identification	30
(e) Hydrology	43
1. General	43
2. 1969 Season	43
3. 1969/1970 Season	43
(f) Sub-population Studies	44
Fishing	
(g) Revised Fishing Techniques	46
1. Trolling	46
2. Gill-netting	47
3. Long lining	48
4. Purse Seining	49
5. Acoustics	49
Catch Results	49
(h)	
1. General	49
2. Effect of Weather	50
Size Range	54
1. General	54
2. Length Composition	54
Conclusions	61
Acknowledgements	61 - 62
References	63 - 64

List of Plates, Figures and Tables

		Page
Plate 1	F.V. "Trade Wind"	
Figure 1	Location and Grid Chart	3
Figure 1a	Commercial Tunas in New Zealand Waters	4
Figure 1b	New Zealand main currents	5
Figure 2	Acoustic Equipment	7
Figure 3	Trolling Rig	11
Figure 3a	Trolling Rig	12
Figure 3b	Trolling Rig	12
Figure 4	Trolling Rig	13
Figure 5	Modified Tuna Longline	13
Figure 6	Gill-net Rig for Small Vessels	14
Figure 7	Length Frequency March 1969	55
Figure 8	Length Frequency January 1970	56
Figure 9	Length Frequency February 1970	57
Figure 10	Length Frequency March 1970	58
Figure 11	Length Frequency April 1970	59
Figure 12	Length Frequency January 1971	60
Plate 2	The Author Shooting 14cm Mesh Gill-net	7
Plate 3	Using Light Coloured Lures During Brilliant Sunshine	8
Plate 3a	Good Catches from "Teaser"	8
Plate 4	Izui Line Hauler Used During Long-lining Experiments	9
Plate 5	Shooting a tuna Longline in the Vicinity of White Island	9
Plate 6	Longline for Albacore	10
Plate 7	A 19 kilo Albacore caught by Longlining	10
Plate 8	Close View of a "Meat Ball" of Anchovies	16
Plate 9	Collecting Anchovies for "Dead Chumming"	16
Plate 10	Experimental Poling for skipjack April 1970	15
Plate 11	Kahawai and Skipjack Feeding Together During Poling	15
Plate 12	Echogram of Anchovies	18
Plate 13	Echogram of Skipjack feeding on Anchovies	18
Plate 14	Echogram of Skipjack feeding on Anchovies	19
Plate 15	Skipjack feeding on Anchovy	19
Plate 16	Echogram of Volcanic Gas Bubbles	21
Plate 17	Echogram of Volcanic Gas Bubbles	22
Plate 18	Echogram of Sea Bed Minor Eruption	23
Plate 19	Echogram of Sea Bed Minor Eruption	24
Plate 20	White Island	25
Plate 21	Albacore Rising Sporadically During Unusually High Temperature Surface Conditions	28
Plate 22	Echogram of Bar Turbulance and Fish	29
Plate 23	Edge of a Five Mile School of Skipjack	29
Plate 24	Leading Vessel being Guided to School of Skipjack and Yellowfin	31
Plate 25	Skipjack "Flashers"	33
Plate 26	"Instant Boiling of Kahawai"	34
Plate 27	Kahawai Breezing After being "Chummed" from the Air (Patea)	35
Plate 28	Large School of Trevally and Small School of Skipjack Breezing after "Chummed" from the Air (Patea)	36
Plate 29	23-25 Schools of Kahawai, Mackerel and Skipjack, 8 Miles South of Wanganui	37
Plate 30	Main Schools Comprising of Mackerel and Kahawai Wit School of Southern Bluefin Working Below Main School	38

		Page
Plate 31	Main School in net - Southern Bluefin Escaping Below Far End of Net	39
Plate 32	Main School Pursed - Note Iridescent Reflection from Mackerel	40
Plate 33	Common Dolphins Delphinius delphis	41
Plate 34	Mixed School of Albacore and Skipjack Feeding on Anchovy	51
Plate 35	Feeding Aggregation of Gannets, Shearwaters and Albacore	52
Plate 36	Feeding Aggregation of Gannets, Shearwaters and Juvenile Yellowfin and Skipjack	52
Plate 37	Approximately 1,400 kg Skipjack Gill-Netted in Two Minutes	53
Plate 38	Unmeshing Skipjack	53
Table A	Summary of Investigations Carried Out from F.V. "Takapu" - Summer 1969	65 - 66
Tables 1-24	Fishing Data from Log Books (All Methods and Vessels) December 1969 to April 1970	67 - 90
Tables B1-B3	Length Frequency Data, Sex and General Gut Content of Skipjack Random Sample for Sub-populations Studies	45 - 46
Table 25	Wind Velocity - January to April 1970	50

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A.G. YORK

INTRODUCTION

During acoustic experiments in the Bay of Plenty from December 1968 and May 1969 (York 1974a) monofilament gill nets were used to provide visual evidence of schooling tunas whilst a hydrophone was receiving feeding signals. Catches resulting from this type of fishing were very encouraging and prompted the Fisheries Management Division to initiate a co-operative fishing programme with the Whakatane commercial and sports fishermen. (Avery 1970, York 1972).

Two commercial boats were chartered between January and April 1970 to guide and advise the participants along the coastal areas from Cape Runaway in the Eastern sector of the Bay of Plenty to Town Point in the Western sector. (Figure I).

The advisory service was extended in the 1970-1971 season to commercial vessels operating from Whakatane and to all interested private game boats.

An extension of the area southwards to include Gisborne and Mahia Peninsula was made in January 1971. (Area 1, Figure 1).

In conjunction with tuna fishing technology other associated facits were studied, including hydrology, acoustic abberations deriving from vessels, sub-population studies and taxonomy.

Air-spotting was an integral part of the programme during the field operations.

This report records the data collected during this investigation.

EQUIPMENT AND METHODS

(a) Vessels

F.V. "Takapu" was chartered from February 26 to April 30 1969 (Table A); and F.V. "Trade Wind" (Plate 1) from January 1 to 31 1970, followed by F.V. "Stranger" being chartered from March 2 to April 8 1970. Twelve commercial fishing vessels were engaged in the co-operative programme from January 1 1970 to April 25 1970. Fishing information collected during the 1970 season is annotated in Tables 1-24.

Numbers of sports fishing boats varied from 10 to 70, all were members of the Whakatane Big Game Club, and fitted with 2.456 Khz crystals, who kept regular schedules with Radio Whakatane (ZLRE) and the project officer of the Fisheries Management Division on the chartered vessel.

(b) Navigation

To facilitate quick reference between a large number of vessels and for rapid interchange of information between adjacent areas to the east and west of Whakatane, charts were divided into two square mile grids (Figure 1) and provided to the chartered vessels, a reasonably precise position was achieved by using horizontal sextant angles of trig stations or known marks, and transferred to the chart by either station pointers or a 25.4 cm protractor.

(c) Fish-Finders

In order to avoid confusion caused by interpreting the traces of the various types of fish finders among the large fleet of small vessels only traces from a 38.5 Khz Simrad (512-13) 0-600 metres are used in this report to illustrate the traces from different species of fish, scattering layers etc.

(d) Acoustic Equipment

The sono-buoy hydrophone used to detect engine noise abberration was a magnetostriction unit designed to receive frequencies from 75 to 6,00 Hz used in conjunction with a Royal New Zealand Air Force R-2A/Arr-3 receiver and recorded on a Nagra Tape recorder with response from 30 to 18,000 Hz (Figure 2).

Limited experiments to lure skipjack were carried out on the sports fishing boats "Bluefin" owned and skippered by H. Davidson in May 1970. (York 1974a).

Both the chartered vessels and many commercial and sports fishing boats were tested for unwanted noise, and advised as to the best trolling speed (York 1964, 1969 and 1974).

(e) Data Recording

Daily log sheets were issued to all vessels, plus a grided chart (Figure 1) to help record all information relating to meteorological and hydrological conditions, concentrations of school fish, catch data and associated presence of birds and mammals.

(f) Hydrology

Two battery operated RS5-3 manually controlled salinometers were installed on board the chartered vessel and were operated whenever practicable, although direct participation during fishing techniques reduced the number of observations, sufficient readings were made to give an overall pattern of the monthly situation.

(g) Fishing Equipment

The twelve commercial fishing vessels operating in the co-operative programme were issued with monofilament gill-nets (Plate 2) and trolling lures (Plate 3). The chartered vessel "Trade Wind" was fitted with an Izui Line Hauler (Plate 4) and the "Stranger" with basic poling equipment (Plates 10, 11).

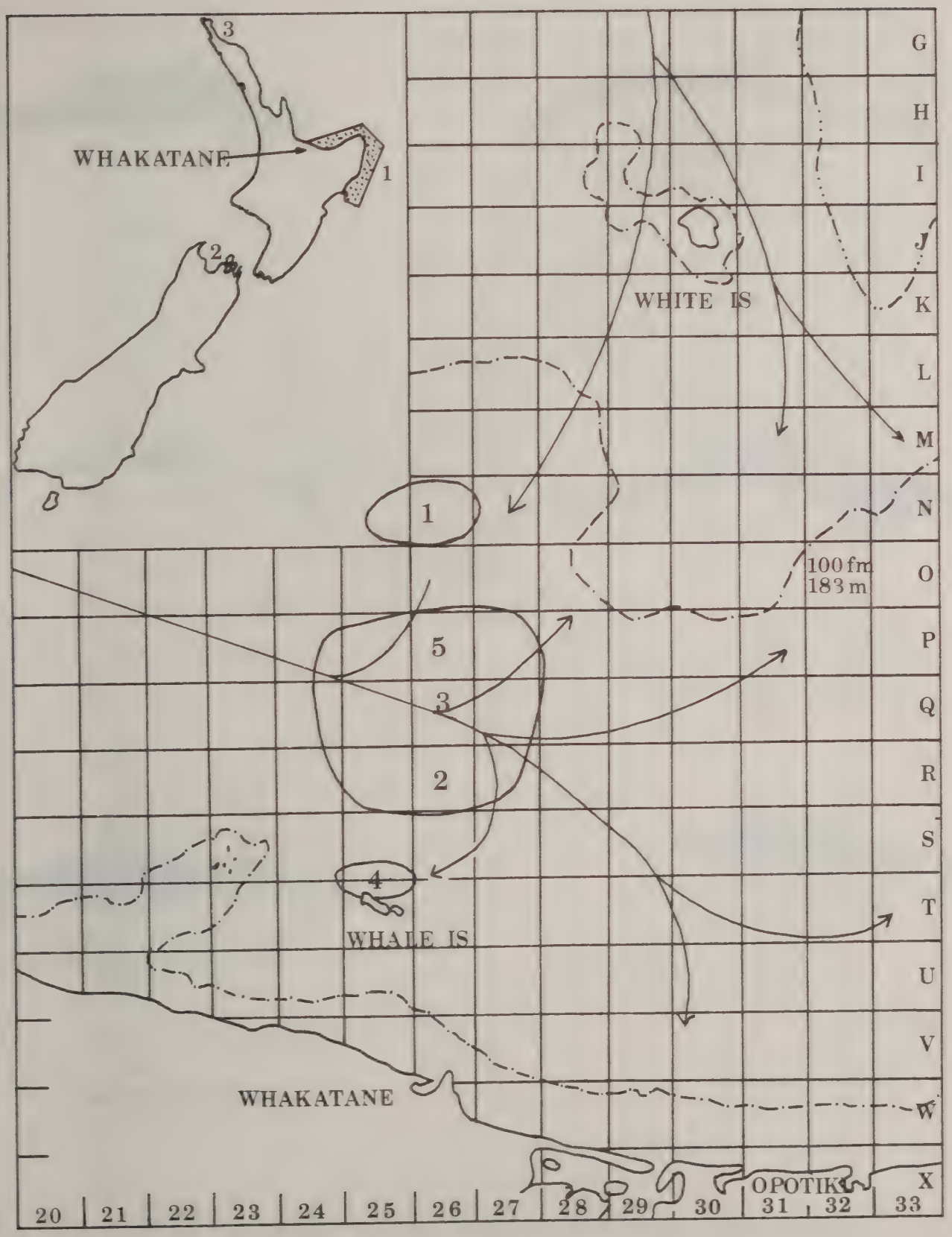


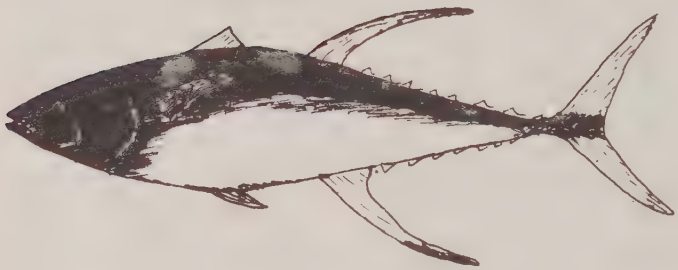
FIG 1 LOCATION AND GRID CHART

Northern Bluefin

Thunnus tonggol

Southern Bluefin

Thunnus maccoyii

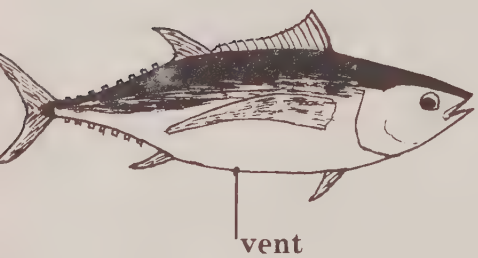


Yellowfin

Thunnus albacares

Albacore

Thunnus alalunga



Bigeye

Thunnus obesus

Skipjack

Katsuwonus pelamis

FIG. 1a

COMMERCIAL TUNAS IN NEW ZEALAND WATERS.

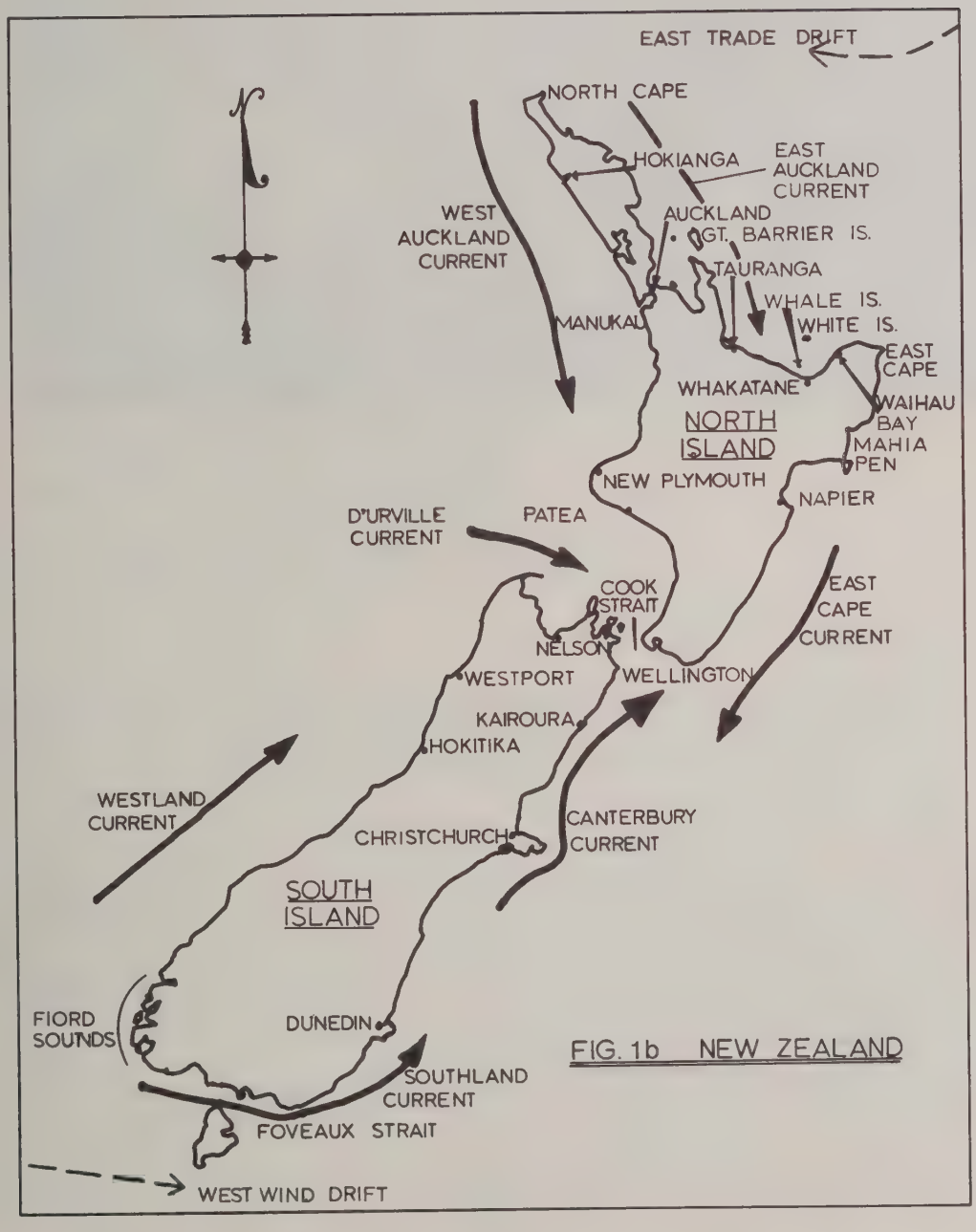


FIG. 1b NEW ZEALAND

Details of the equipment are listed below:

1. Gill nets - Cork line length 146 metres
Mesh size 14 cm
Depth 150 meshes
Lead or ground line was nylon with a lead core.

2. Trolling Lures - Mainly Japanese plastic "squids" and "octopus" from 7.5 cm to 18 cm in length.

Trolling Rig - Several patterns were used, but those described by Crious 1961 (Figure 3) and York 1969 (Figure 4) appeared to have advantages over other patterns, and are discussed on page

3. Long-Lining Equipment - The general layout of the modified long lining gear is an adaption of similar gear used by small boats from Gloucester, Massachusetts, Wilson 1960, and some aspects of shark line gear (York, 1970 a 1975). (Plates 4-7 and Figure 5.)

4. Live Bait and Pole Lining - Three sets of "small tuna" poling gear was made up, using standard Japanese bamboo poles, feather jigs and rubber apron, both methods of "live" and "dead" bait chumming was implemented. (Plates 8-11.)

5. Purse Seining - General comments are discussed in section "Field operations and results".

(h) Sub-Population Studies

Samples of skipjack heart blood were taken by hypodermic syringe, preserved and sent to the former Bureau of Commercial Fisheries Biological Laboratory, Honolulu, for analysis in connection with sub-population studies by Dr K. Fujino.

(i) Air Spotting

A Cessna 185 high wing monoplane was periodically chartered during all seasons, but in the early part of the 1970 season, the pilot G. Bell was trained in pelagic fish spotting and by March 1970 the plane was advising the fleet on courses to steer to intercept the fish approximate tonnage of the school and guiding commercial and game boats to a position for either gill-netting, trolling, poling or combined 'chumming' with all three methods.

Communication was maintained from 'plane to ship' on the allocated frequency of 2.456 Khz.

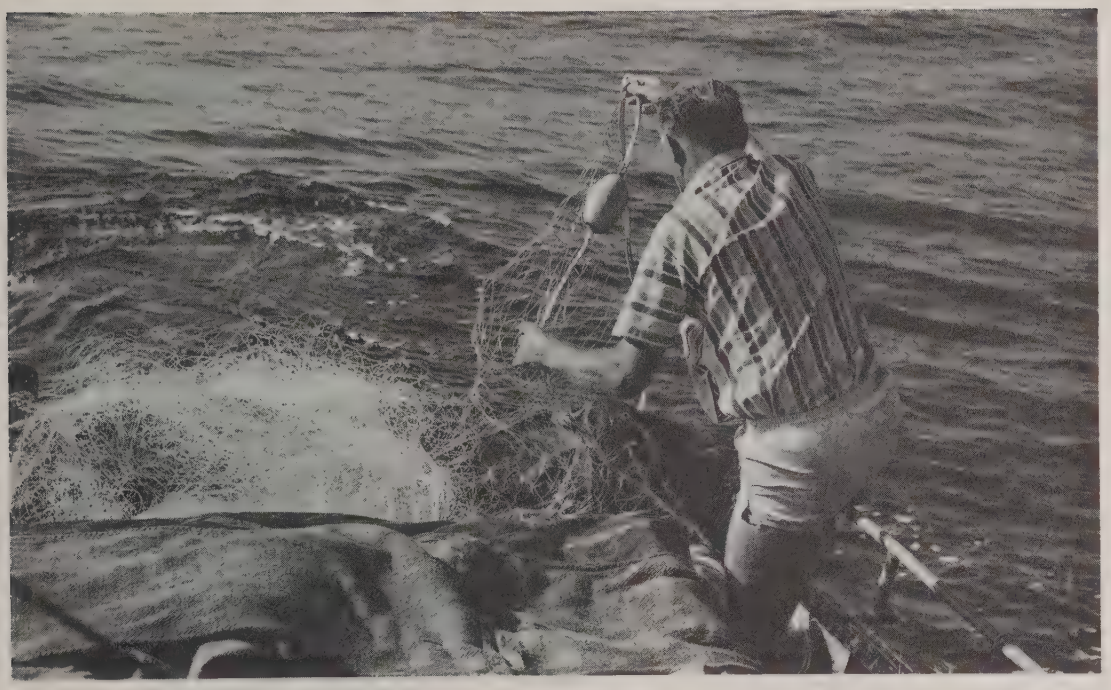


PLATE 2 THE AUTHOR SHOOTING 14 cm MESH GILL NET.

FIG. 2. ACOUSTIC EQUIPMENT

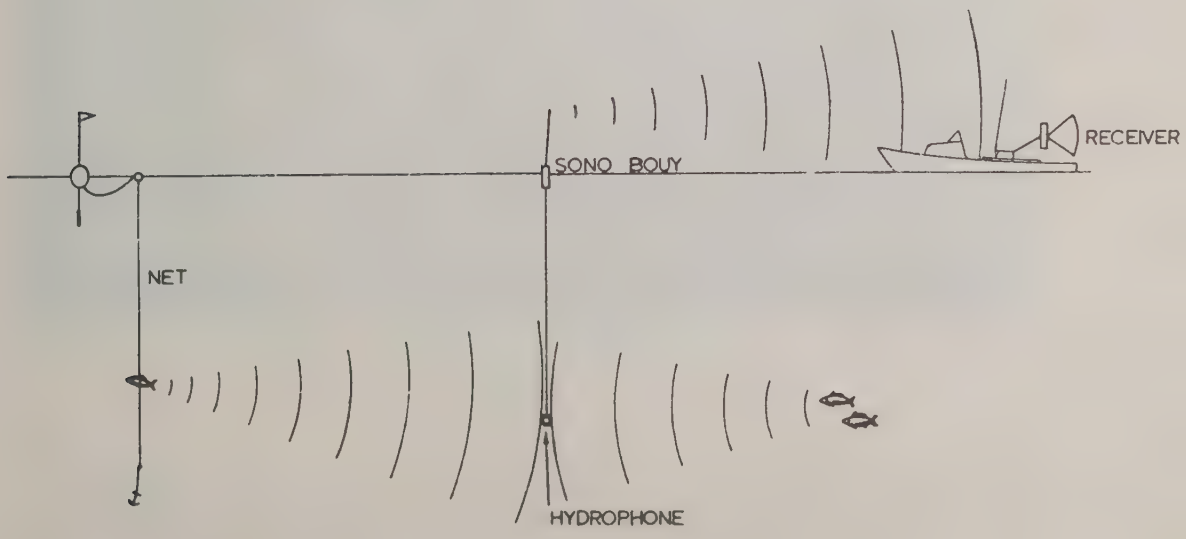


PLATE 3

USING LIGHT COLOURED LURES DURING BRILLIANT SUNSHINE.

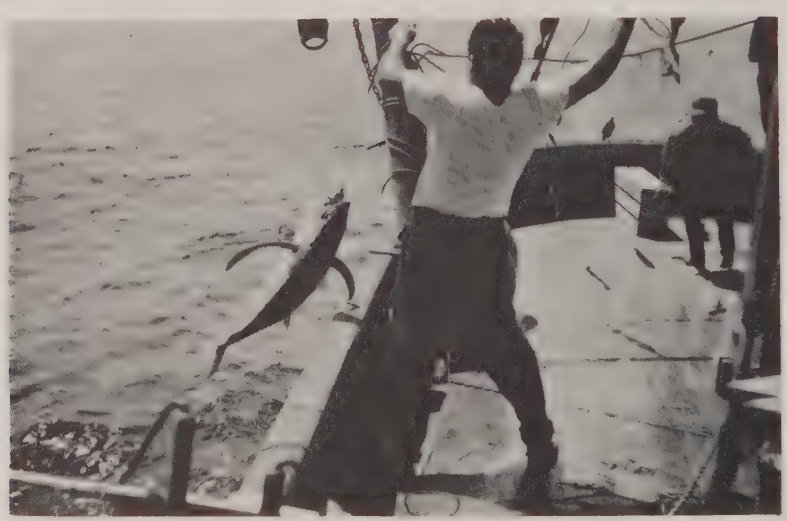


PLATE 3a

GOOD CATCHES FROM 'TEASER'.

PLATE 4

IZUI LINE HAULER USED DURING LONG-LINING EXPERIMENTS.

PLATE 5

Shooting a Tuna Long Line in Vicinity of White Island

PLATE 6

Long Lining For Albacore

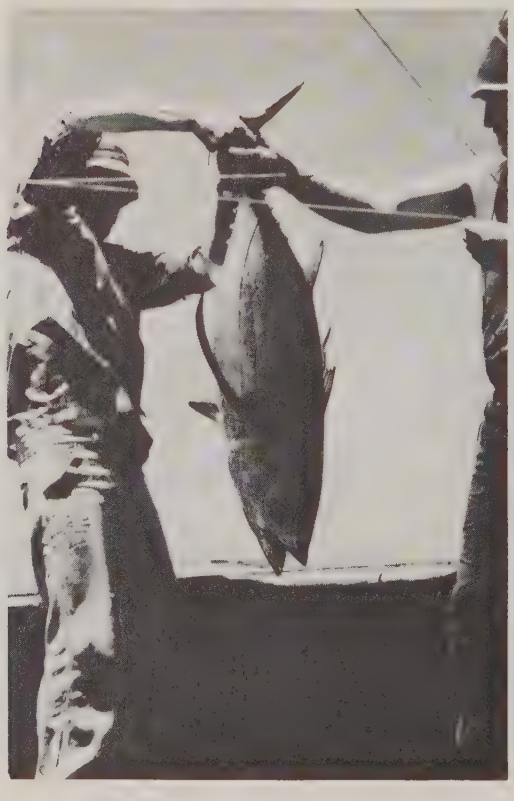


PLATE 7

A 19Kilos Albacore Caught By Long Lining

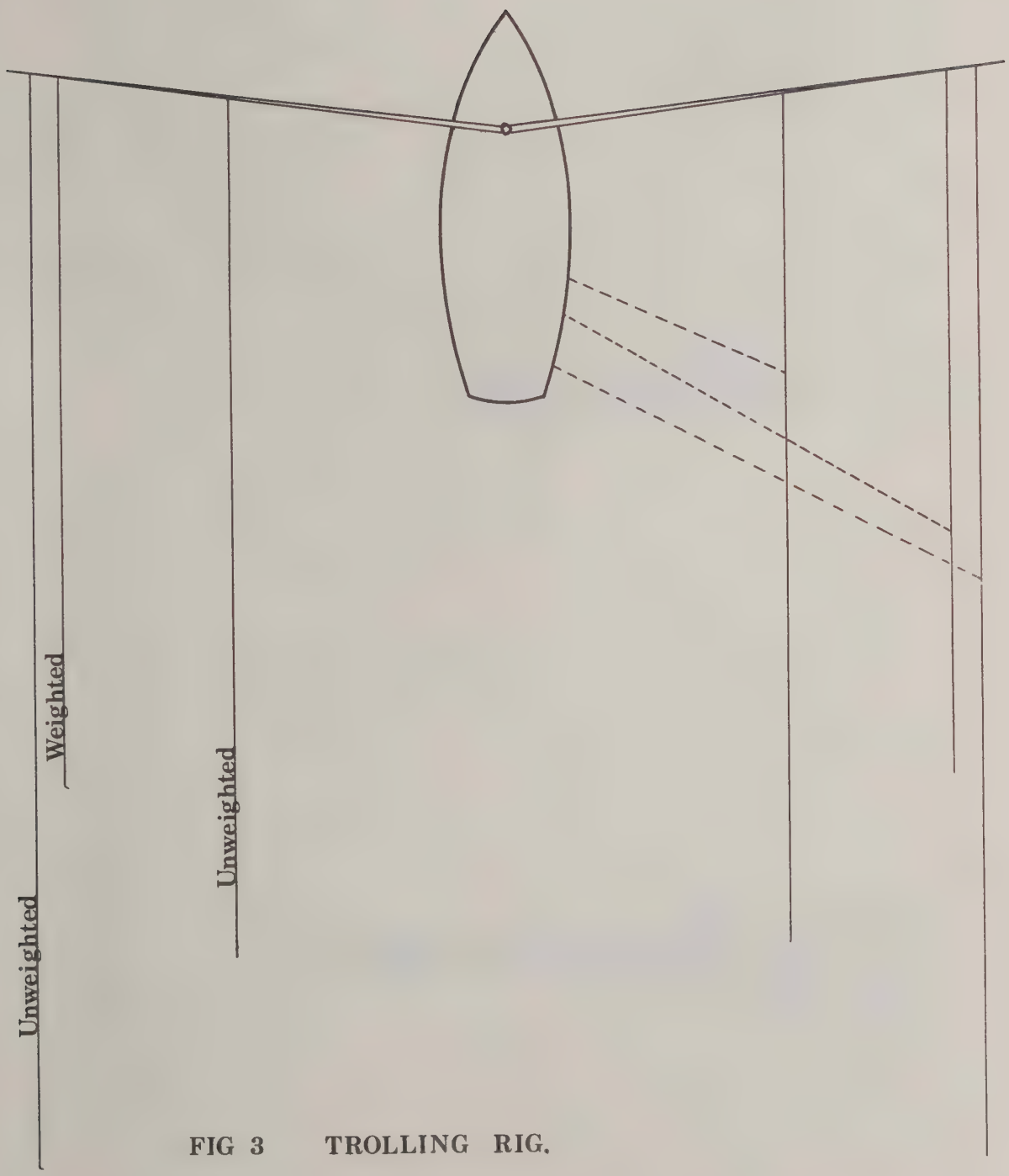


FIG 3 TROLLING RIG.

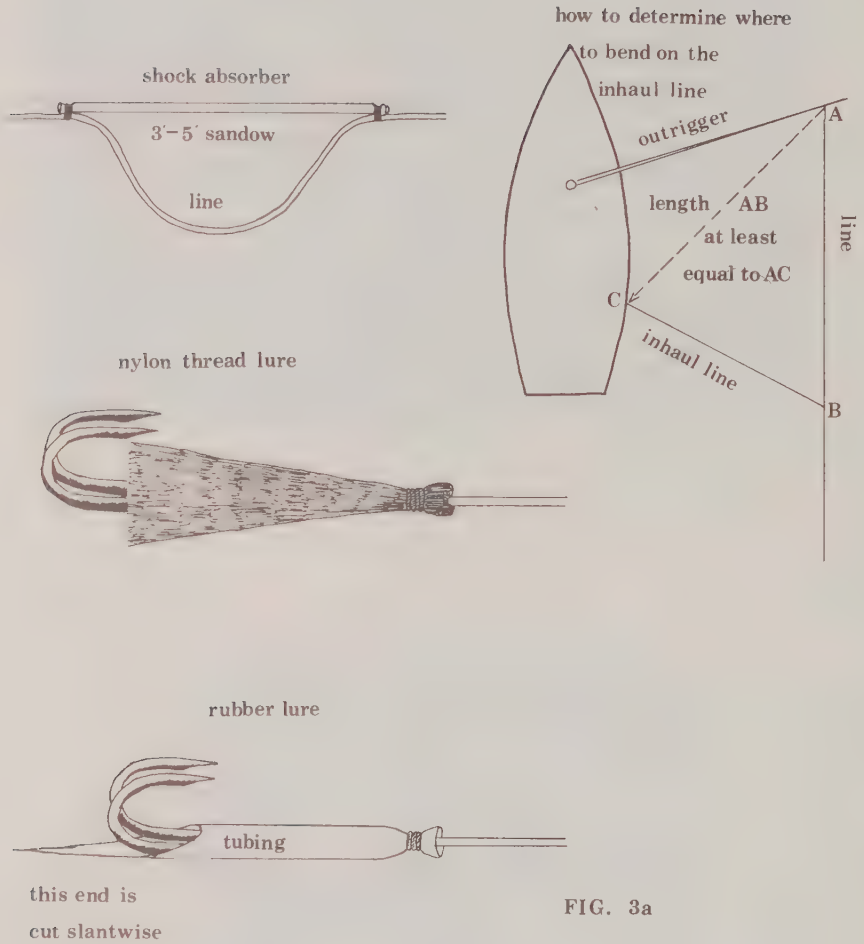


FIG. 3a

WOOL 2" BEYOND
HOOK

FIG. 3b

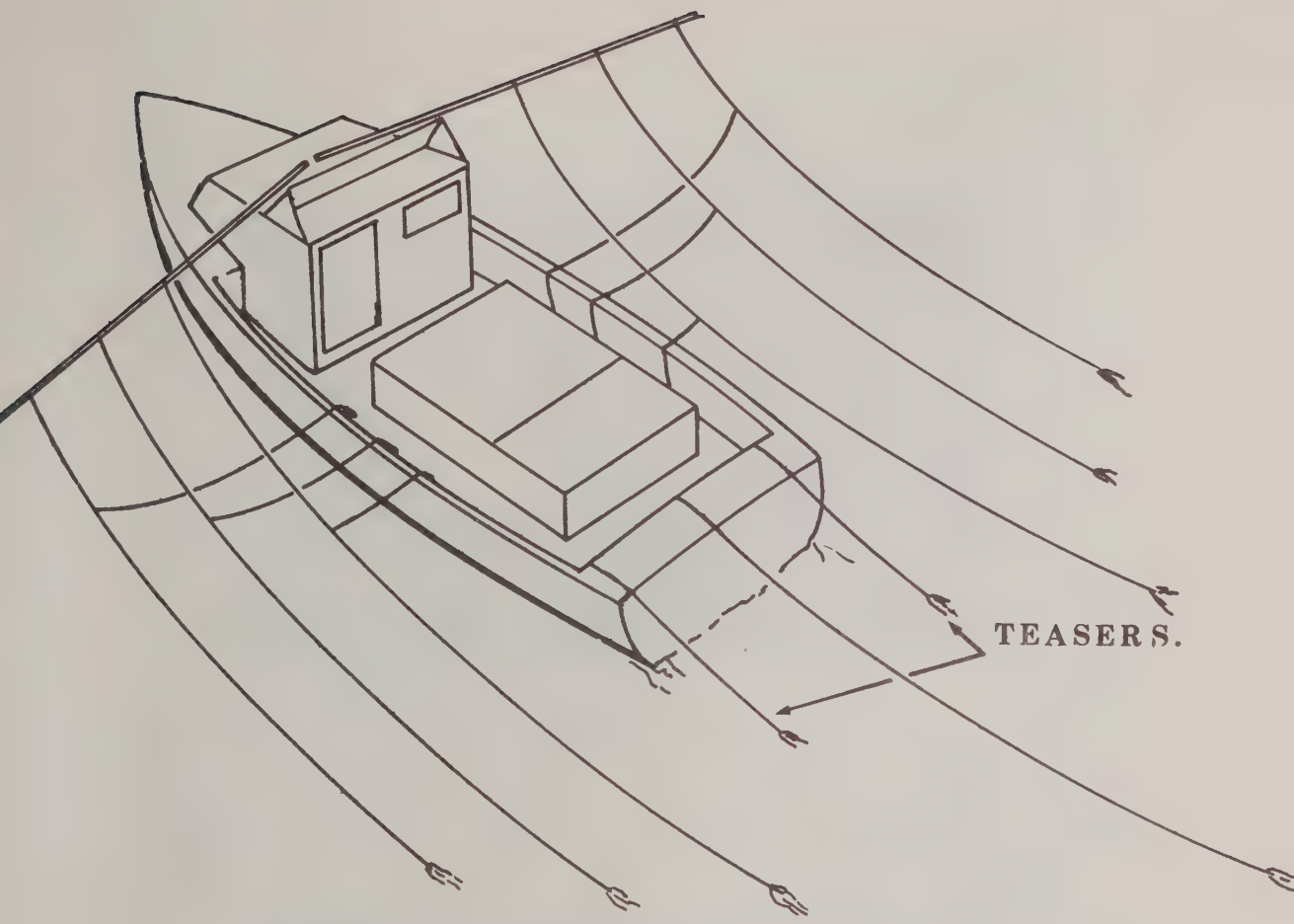


FIG. 4 TROLLING RIG.

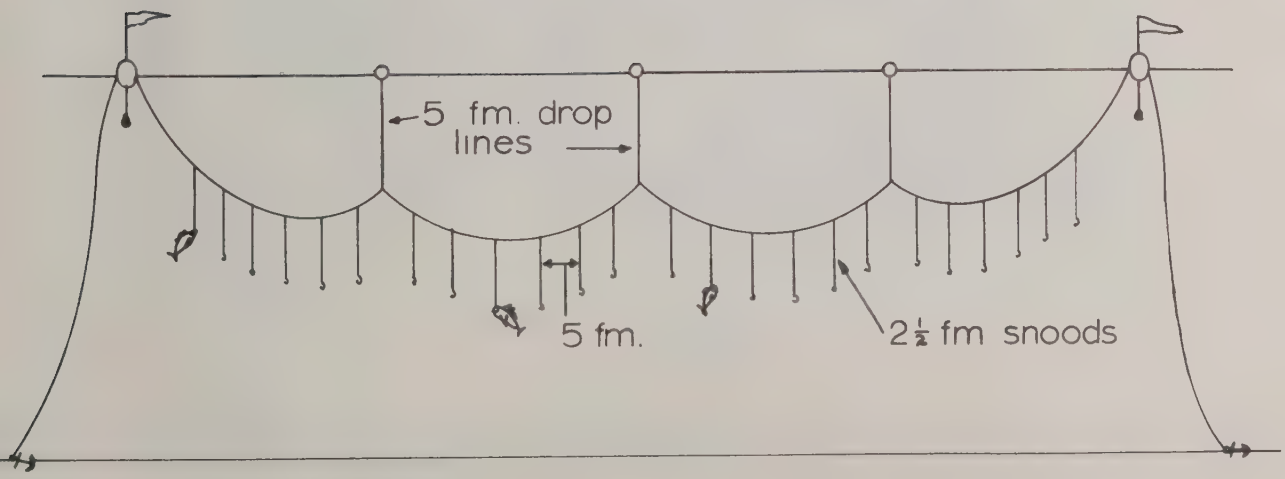


FIG. 5. MODIFIED TUNA LONG-LINE

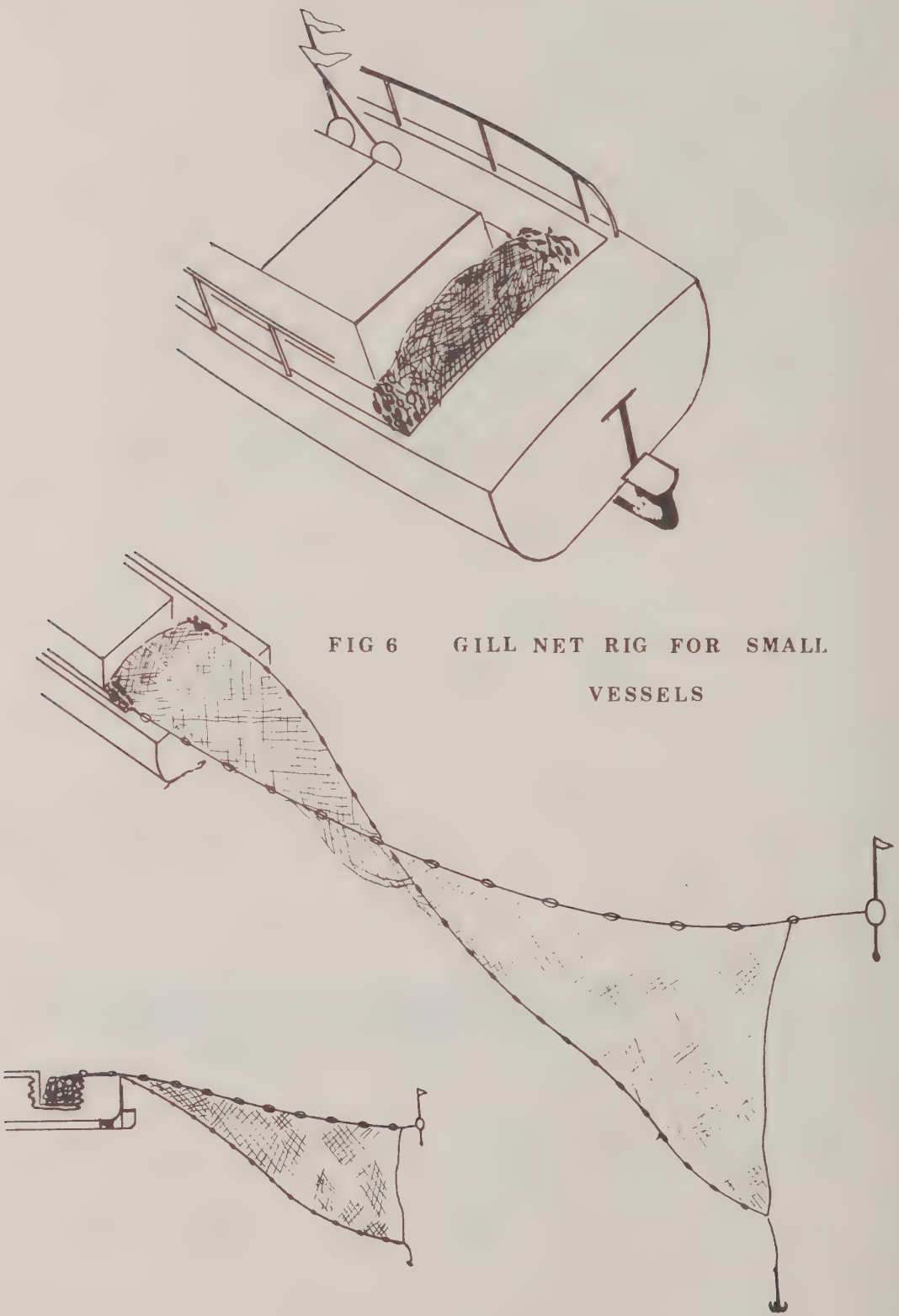


FIG 6 GILL NET RIG FOR SMALL VESSELS

PLATE 10

EXPERIMENTAL POLING FOR SKIPJACK APRIL 1970.

PLATE 11

KAHAWAI AND SKIPJACK FEEDING TOGETHER DURING POLING.

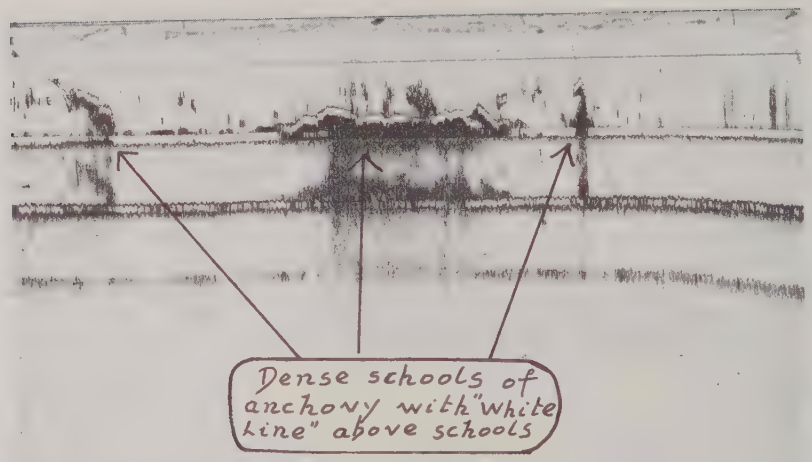
PLATE 8

CLOSE VIEW OF A 'MEATBALL' OF ANCHOVIES.

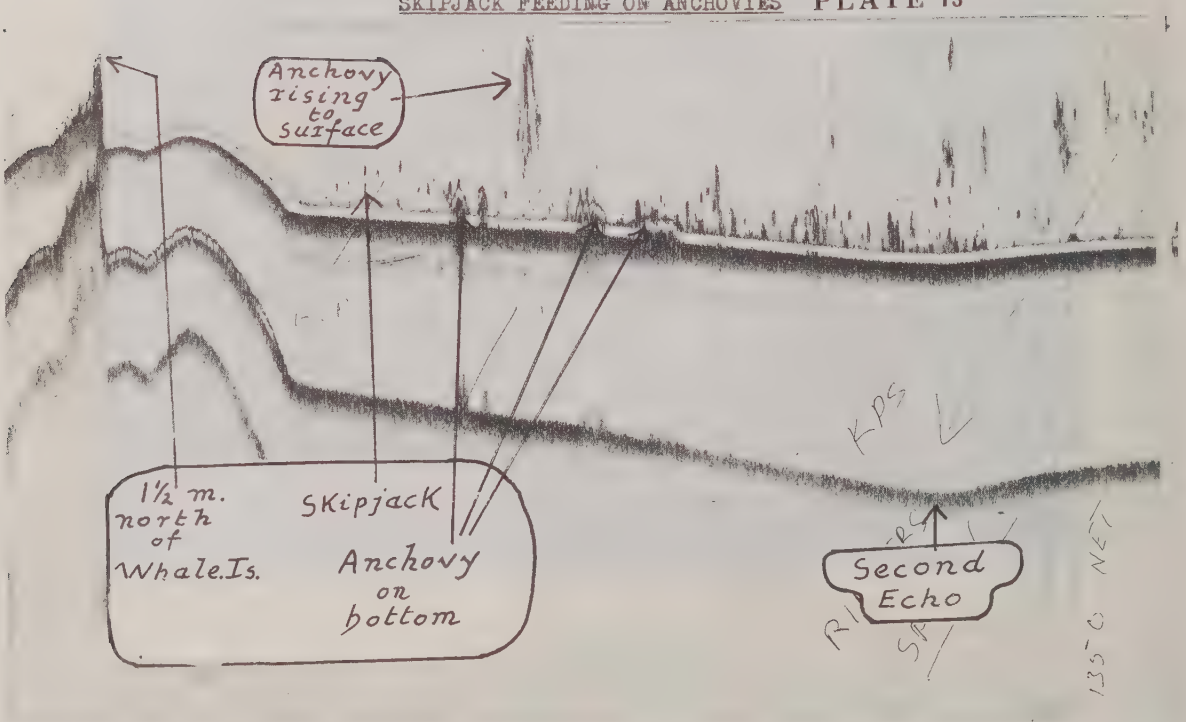
PLATE 9

COLLECTING ANCHOVIES FOR 'DEAD CHUMMING'

PLATE 12



SKIPJACK FEEDING ON ANCHOVIES PLATE 13



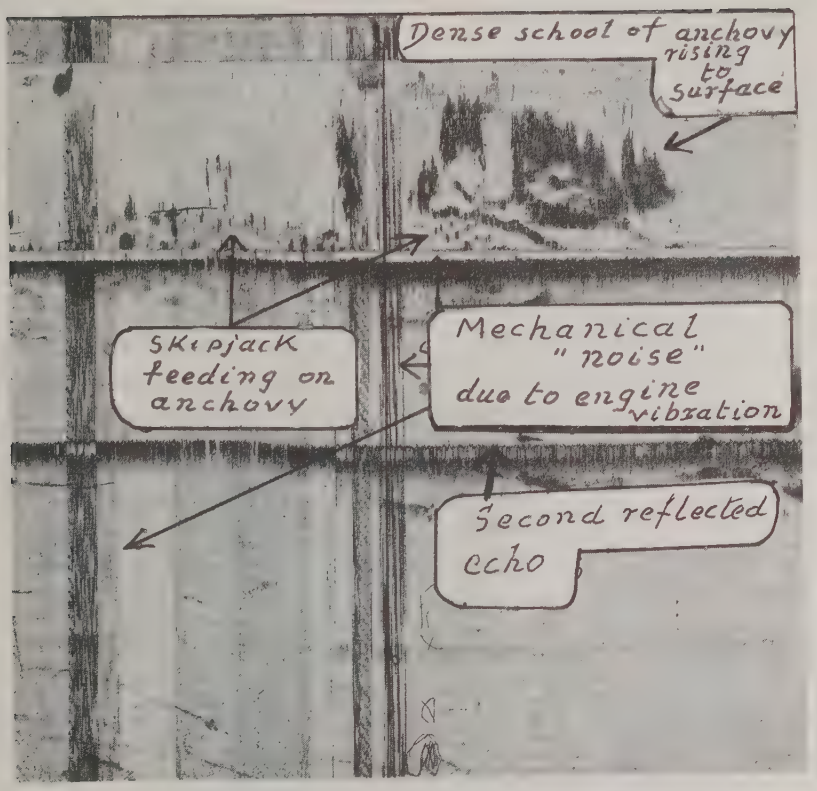

Dense school of anchovy rising to surface
Skipjack feeding on anchovy
Mechanical "noise" due to engine vibration
Second reflected echo

PLATE 14

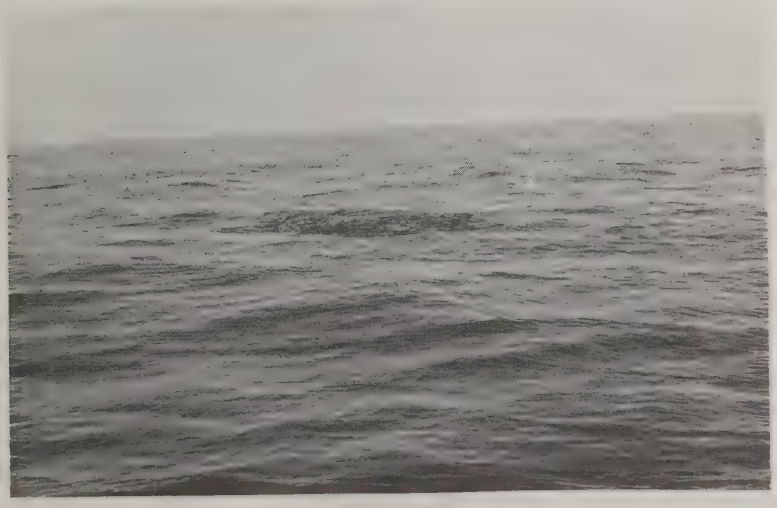


PLATE 15

SKIPJACK FEEDING ON ANCHOVY

FIELD OPERATIONS AND RESULTS

(a) General

Before commencement, boat skippers, Whakatane Big Game Club members, fish processors and the spotter pilot were briefed on all aspects of the programme.

As vessels varied in length, shape and engine design, the project officer or assistants spent sufficient time to advise the most efficient trolling and gill-netting rig. The term 'season' relates to the inshore migration of tuna which is approximately from late November to the end of May depending on general hydrological conditions.

(b) Navigation

The commercial fishermen fix their positions by land transits and general local knowledge of visual topography, so the grid system of positioning was quickly adapted as these vessels radioed fairly accurate sightings of tuna schools and catches to the other boats.

The positioning of schools sighted by chartered vessels was also radioed to the spotter plane as well as other boats, thus allowing the plane to keep a school under surveillance and pass on all relevant information as to size of school, direction of movement, species and position.

(c) Instrument Fish Finding

The complex bathymetric and geothermal features in the area between Whale and White Islands often led to some confusion when interpreting true fish echoes as distinct from turbulance or thermal activity (Plate 16).

On board the chartered vessels echograms recognisable as tuna or other fish echoes, were verified before being relayed to fishermen.

When tuna or bait fish were not visible an acoustic search with the Simrad fish finder was carried out to locate their presence and depth, advice was then given with regard to school density, and the most suitable catching method, depending on the school depth. In a situation where dense schools of baitfish were feeding on the bottom (Plates 12 and 13) the vessel 'tracked' the school (Plate 13) until it either started to surface or was driven rapidly by predatory skipjack (Plate 14) to break the surface as shown in Plates 8 and 15.

Thermal activity appeared to increase during the 1969 acoustic experimental survey and in areas of dense eruptions (Plate 16 to 18) only dolphin (Delphinus delphis) whose transmission appears as small dots on the echogram (Plate 17) were sighted in the immediate vicinity. Small schools of fish were seen fairly close to minor eruptions (Plate 19). In January 1970 surface temperatures reached an unusually high average of 23.1°C (Table 2) and in the White Island (Plate 20) area the albacore (Thunnus alalunga) were surfacing in small pockets for periods between 5 and 20 minutes, and this behavioural pattern can be seen in Plate 21.

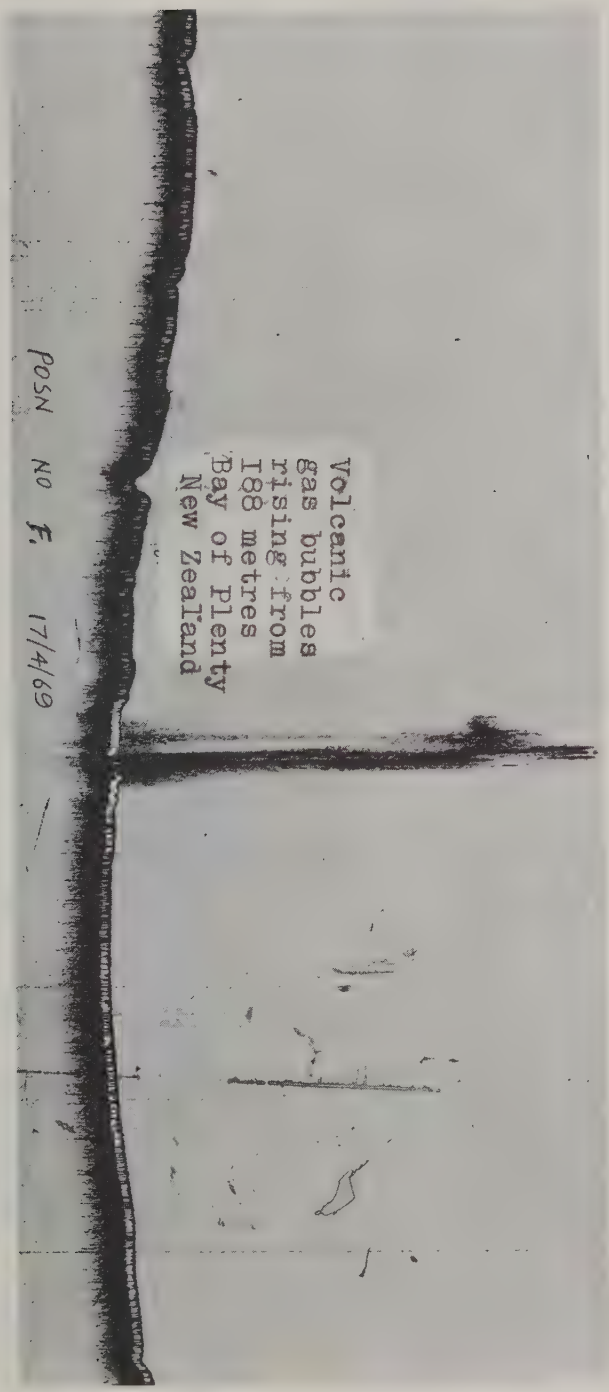

Volcanic
gas bubbles
rising from
188 metres
Bay of Plenty
New Zealand
POSN NO F. 17/4/69

PLATE 16

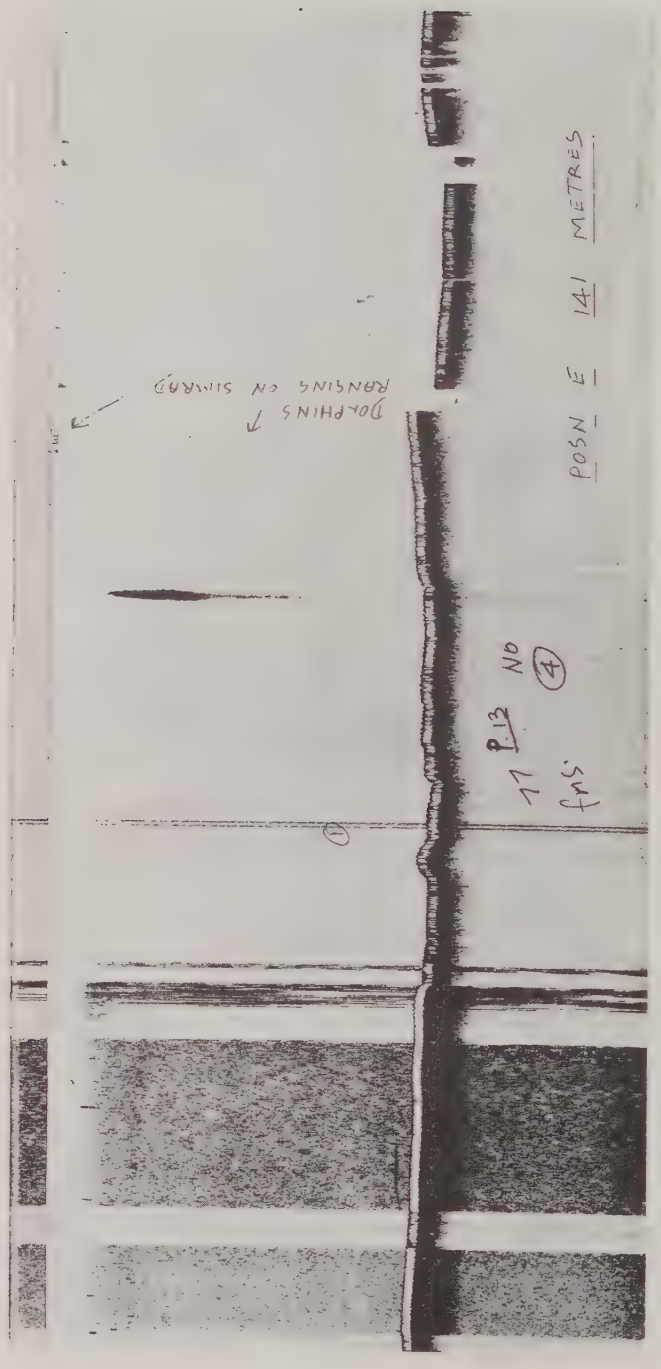


PLATE 17

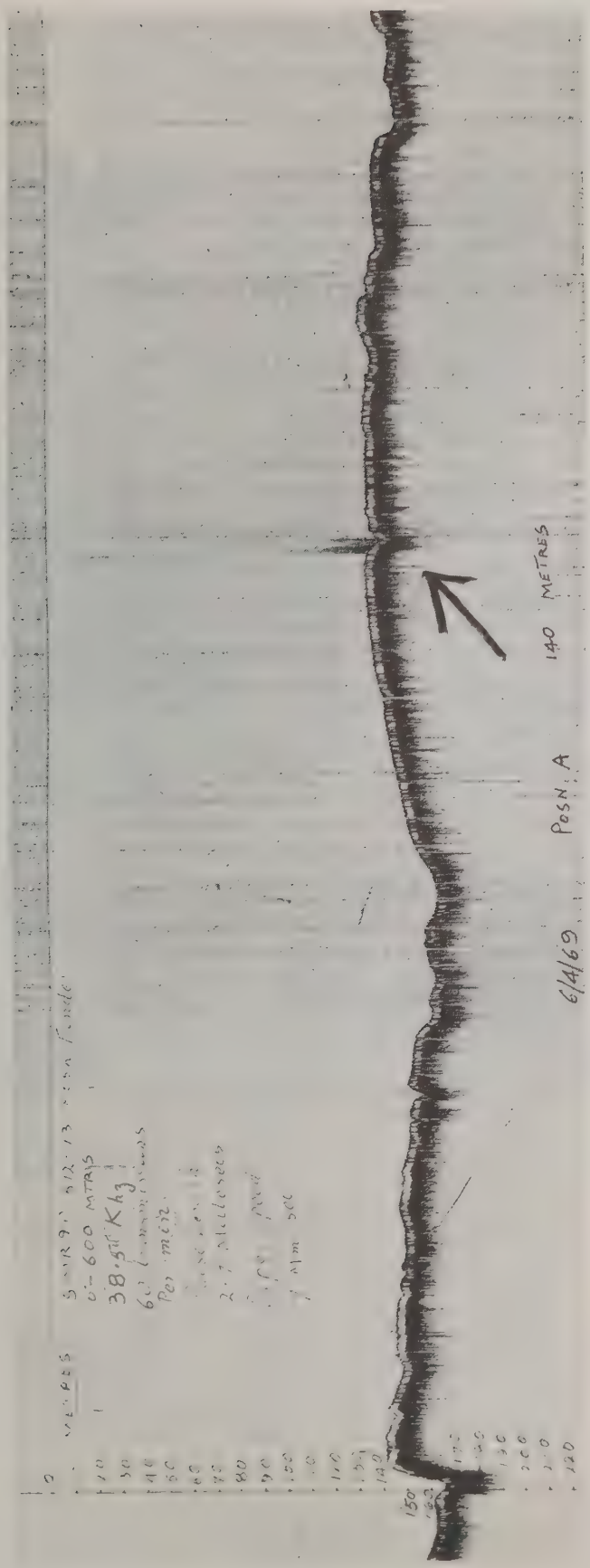


PLATE 18

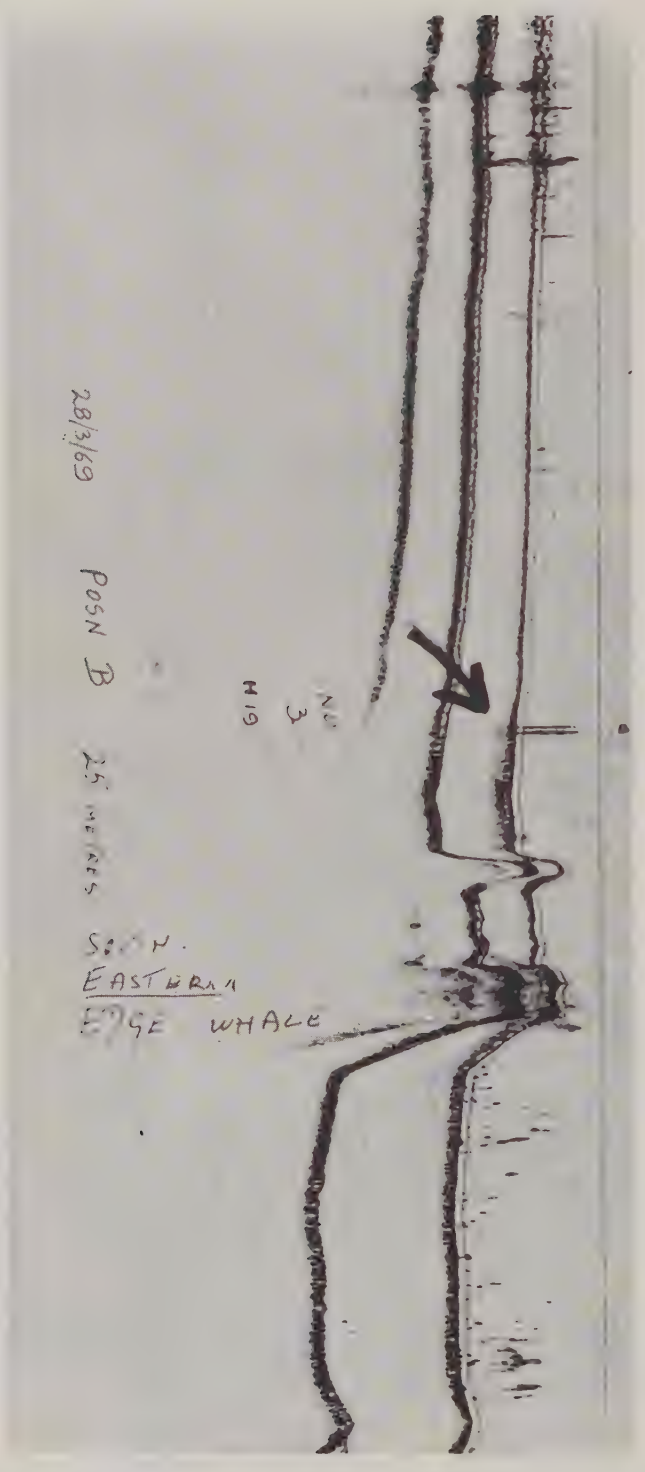


PLATE 19

PLATE 20 WHITE ISLAND.

During this period catches were made as early as two hours before sunrise and sporadically during the day, and until 1½ hours after sunset.

It appeared that the tuna remained in the deeper, cooler layers during the day, surfacing briefly to feed. Continuous feeding occurred before solar radiation affected the surface. The turbulence at the River-Whakatane bar is shown by the echoes on the left of a line (Plate 22). The dense cluster of echoes upstream from the bar (to the right of the line) are from yellow-eyed mullet (Aldrichetta forsteri).

d) Air Spotting

General

The Cessna proved to be ideal for pelagic fish spotting, having excellent visibility and flying speed low enough to give accurate identification at heights between 305 and 365 metres and sufficient manoeuvrability to hold in sight a school of fish under most light conditions. When spotting for pelagic schools, particularly close inshore where water colour can alter rapidly, a sound knowledge of school behaviour patterns, and the colour of a school which differs with changing water colour or the amount of cloud cover are prime factors for identification.

During the 1970/71 season the plane was spotting schools of tuna, advising the Whakatane fleet on courses to intercept the fish, approximate tonnage of the school, and guiding vessels and game boats to a position for either gill-netting, trolling, poling or combined chumming with all three methods, depending on the behavioural pattern of the school. When the Cessna flew over a school at 150 metres or lower the engine noise would invariably cause the school to sound; most schools would scatter or sound if the shadow of the plane passed over them.

In February 1971 a small and rough paddock was used as an airstrip to extend some air spotting in the eastern end of the Bay of Plenty using a Piper, piloted by J. Perry of Opotiki, and further spotting was carried out at regular intervals from Gisborne and New Plymouth; in fact many interested fishermen and processors were given the opportunity to view tuna schools from the air.

An air-spotting advisory service was requested by the charter of the USA purse seiner 'Esperito D'Santo' (D. Urquhart) operating from New Plymouth, and as much time as possible was allocated to this project, at the same time liaison with the Bay of Plenty, Gisborne and Mahia areas was maintained only by working every day of the season excepting during adverse weather. The requirements of the North Island, and the North/West sector of the South Island, and over 200 hours flying was logged during the 1971 season.

1970/71 Season

All flights prior to December 1970 were devoted to training the pilot, G. Bell, and to assess the suitability of the Cessna.

All days in January 1971 suitable for air spotting in the Whakatane area were used and a standard operational spotting procedure was devised. Upon sighting a school of fish the position, species, approximate tonnage, movement, presence and behaviour of birds or mammals and school behaviour of the fish was relayed to all the fleet. Those boats within close proximity of the fish were given an interception course. If most of the vessels were not more than 30 minutes from the schools the plane would remain near the fish and direct the vessels to the position.

When large concentrations of surface feeding tuna (as shown in Plate 23) were spotted, the general school information was relayed, and the plane would keep the school under surveillance and advise the best method to fish the school; if the school appeared to be static and the fleet was more than one hour's steaming distance from the school, then the plane would return to the airfield, after giving the boats a course to steer. It would then take off again in time to be in position to advise the fleet nearing the original school position as to the need to make any course alterations.

On January 19 four commercial and six sports fishing boats were guided into a large school of skipjack and yellowfin (the leading boat can be seen in Plate 24). As gannets (Sula bassana serrator) and other birds were seen to be feeding close to the surface, the gill net method was used by commercial boats, while the sports fishermen trolled around the edge of the school. One sports fisherman was guided onto a large shark heading for struggling skipjack in a commercial fisherman's gill net; the commercial boat landed over 1,000 kgs of tuna and the sports fisherman a trophy for his club.

During February the spotting service was extended down the east coast to Mahia Peninsula and northwards to Whitianga (Figure 1) and limited operations were carried out with the Gisborne purse seiner, a Tauranga based live bait/pole-lining vessel, and the fleet of day boats operating from Waihau Bay in the eastern sector of the Bay of Plenty.

By the end of February the spotter plane had tracked tuna school movements from 80 km offshore to close inshore feeding grounds and established that during the early part of the 1970/71 season, yellowfin were evident from the air before any other species followed by albacore and northern bluefin, then southern bluefin and skipjack. The inshore migratory routes are marked by arrowed lines on Figure 1, the yellow fin, albacore and northern bluefin with the skipjack from west to eat. It must be pointed out that the sightings from the air are not necessarily the correct order of appearance as some species may be too deep to be observed from the air. The order of appearance from commercial catches will be discussed under 'Catch Results'. Yellowfin and skipjack were forming large feeding aggregations, on the evidence of air spotting, during the first week of March along the continental edge south of White Island (Figure 1). Small commercial vessels ranging from 6 to 15 metres were guided by the spotter plane to the schools. Landings averaged 600 kgs. Two of the smaller vessels F.V. "Catchem" and F.V. "Comrade" were guided by the plane to a school of skipjack that was feeding several metres below the surface, and directed to shoot their gill nets. From the plane the skipjack could be seen striking the net and the cork line sinking. The whole operation took three hours for the vessels and one hour for the plane.

From March 9-24 1971 the vessel "Esperito D'Santo" and the Fisheries Management Division shared the cost of the air spotting service for this in experimental tuna purse seining programme, based at New Plymouth (Figure 1b). The plane successfully guided the vessel to schools of albacore and skipjack in the New Plymouth area on six occasions, but because the majority of the crew were

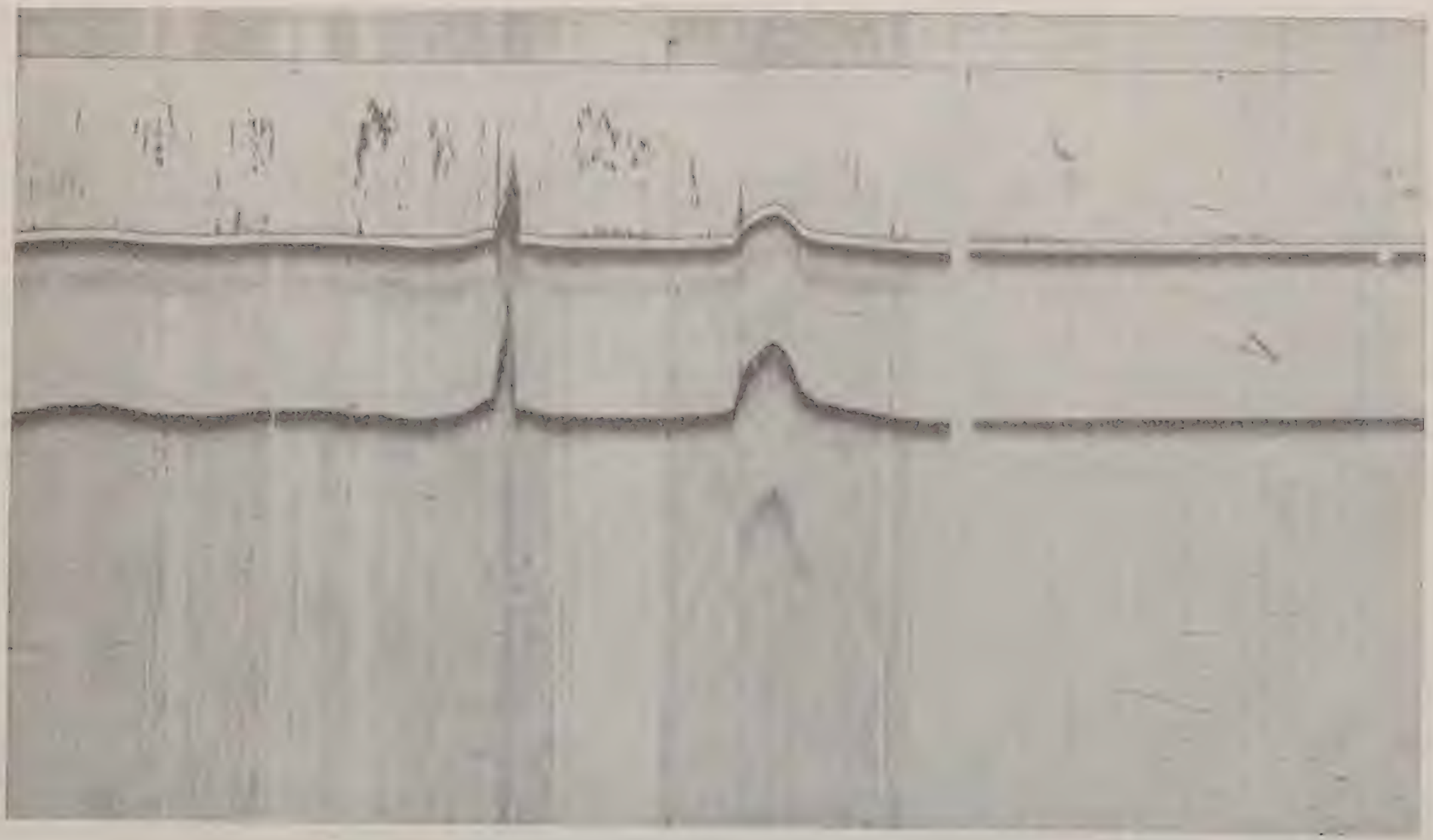


PLATE 21 ALBACORE RISING SPORADICALLY DURING UNUSUALLY HIGH TEMPERATURE SURFACE CONDITIONS.

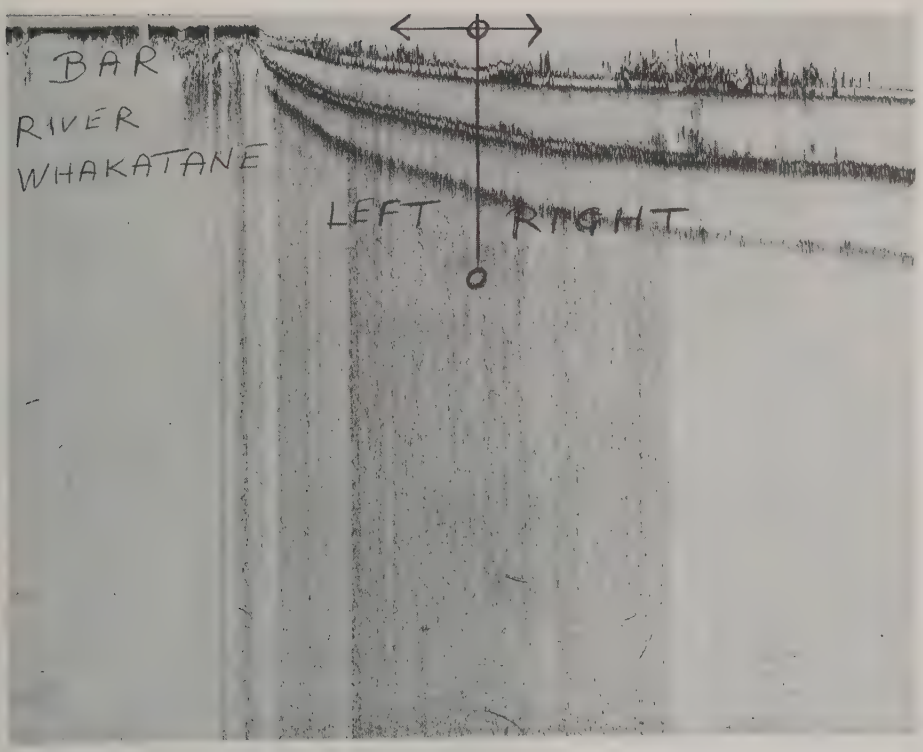


PLATE 22

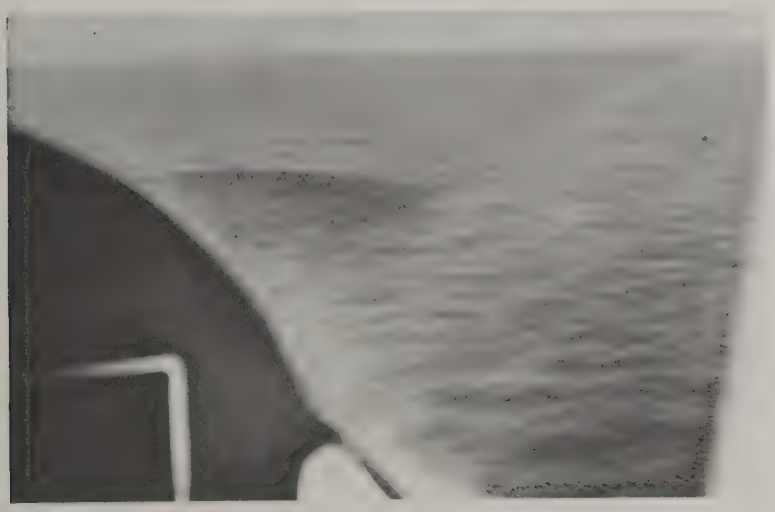


PLATE 23

EDGE OF A FIVE MILE SCHOOL OF SKIPJACK.

inexperienced three attempts proved fruitless when the tow parted from the tender and by the time the net was ready to shoot again the tuna had sounded. On a further two operations the seiner could not shoot the net because small local vessels steamed across the schools and placed themselves in jeopardy of collision with the "Esperito D'Santo". On the sixth occasion the vessel was guided to a school of albacore and the net was shot around the school, estimated at 80 tonnes. Unfortunately, a purse clip became entangled with the cork line leaving a large opening for the albacore to swim clear of the net.

Toward the end of March a technique for 'chumming' surface fish from a plane was implemented and on the two occasions when weather permitted (Plates 27 and 28) trevally (Caranx lutescens), skipjack and kahawai (Arripis trutta) were induced into a feeding frenzy. Several kahawai were minced into a paste and put in plastic bags tied very lightly around the neck. The school of fish was then approached at approximately 150 km/per hour, the bags being released from a height of 76 metres to burst on the surface close to the school. The fish scattered as the bait burst, but within a few seconds they started to feed and remained as a school for 15 minutes.

Air spotting continued in early April and at the request of a representative of the "Esperito D'Santo" (Mr J. Maynard) tuna spotting around the North Island and as far south as Nelson in the South Island was carried out. The vessel at this stage was looking for denser, easier-to-surround tuna schools than those seen in the New Plymouth and Patea area (Figure 1). The sequence of Plates 29-32 illustrates both the advantages of air spotting and the difficulties of actually seining the fish.

The "Espirito D'Santo" arrived in Cook Strait on instructions from the plane. Numerous schools like those in Plate 29 were evident. The vessel was guided to a mixed school of English mackerel (Scomber australasicus), kahawai and southern bluefin (Thunnus maccovii). In Plate 30 the kahawai (marked K) are foaming briskly on the surface, while the mackerel are just below the surface (marked M), and the southern bluefin (marked T) can be seen several metres below the other fish. The spotter suggested to the fishing master that it should be possible to separate the schools as the mackerel and kahawai appeared to be very 'spooky', but as the fishing master could not see the tuna, he shot around the whole school. The observers in the plane watched the schools separate (Plate 31) and the southern bluefin swim below the net and escape. When the net was pursed only kahawai and mackerel were in the net (Plate 32). A live bait/poling vessel, F.V. "Pirimai" was landed mixed schools of kahawai and southern bluefin one kilometre closer inshore. The incident made it clear that the schooling behaviour of pelagic fish in New Zealand waters was very different to that in other fishing areas they had visited.

School Identification

Skipjack

Plate 25 depicts the sun reflecting on silvery ventral and part lateral surfaces and is termed either 'flashers' or 'shiners', this stage is often followed by the best-recognised pattern of 'foaming', 'boiling' (this term is sometimes used for 'shiners' or 'flashers') which appears to start along one upper edge of the school and fold over in a wave form. The leading edge of a school in Plate 23 is about to break water, or 'foam'.

PLATE 24. LEADING VESSEL BEING GUIDED TO SCHOOL OF SKIPJACK & YELLOWFIN.

When a school of skipjack is not actively feeding but swimming on the surface in search of food it appears as a flat spot or 'breezes' and the solid mass of fish underwater may appear as a 'black ball' or a spot darker than the surrounding water. Small schools rising to the surface in the sunlight show up as bright, iridescent blue patches.

Albacore

Albacore are fairly difficult to distinguish from the surrounding water unless they are close inshore in green water when the school will appear as a 'black ball'. At low altitudes occasional 'finners' (dorsal fin or tail seen from a few fish) can be observed. On rare occasions in the oceanic blue water, schools of albacore appear as areas of blue/green 'shiners', an effect occurring when the iridescent colouring along the lateral line reflects the sunlight. This effect was very prominent from the plane when spotting (at 320 m) for the fishermen in January 1971 in the White Island trench area (Grid J31, figure 1), especially when an albacore was being hauled to the surface on a trolling line and other albacore often swan swiftly on their sides and the lateral and ventral surfaces reflected the sunlight. In calm seas a school of albacore often appears as a distinctive 'ripple' on the surface which changes to a 'black ball' or 'black spot' when the school is directly below the plane.

Yellowfin

In New Zealand waters this species usually schools with other tunas, mainly skipjack, consequently the air spotter has to identify the mixed school behaviour and also the appearance, on rare occasions, of small yellowfin schools usually seen as 'black spots' in coastal blue waters. In such schools occasional 'jumper' (an American term for individual leaping fish) whose fins and finlets can be seen as yellow flashes from the plane at low altitudes.

Plate 24 shows a mixed school with a typical skipjack 'fold' boiling heavier on the lower part of the school, and in the area marked 'Y' the yellowfin were seen to be several metres below the skipjack showing up as a faint black spot.

Southern Bluefin

In the author's opinion - based only on New Zealand sightings - this species is the most difficult to identify from the air. On occasions this species will have the appearance of a 'black spot' seen in albacore schools. At altitudes over 700 metres the southern bluefin, when leaping out of the water, can be mistaken from the plane for common dolphins (see Plate 33).

No schools of northern bluefin were seen from the air although small catches of this species were made by commercial and game fishermen.

Kahawai

This species is easily recognised by the instant 'boiling' or 'foaming' as the fish break surface. There is no fold action as the surface boils instantaneously across the whole school area; the same action can be seen immediately following the chumming of the school in Plates 26 and 27.

PLATE 25 SKIPJACK 'FLASHERS'

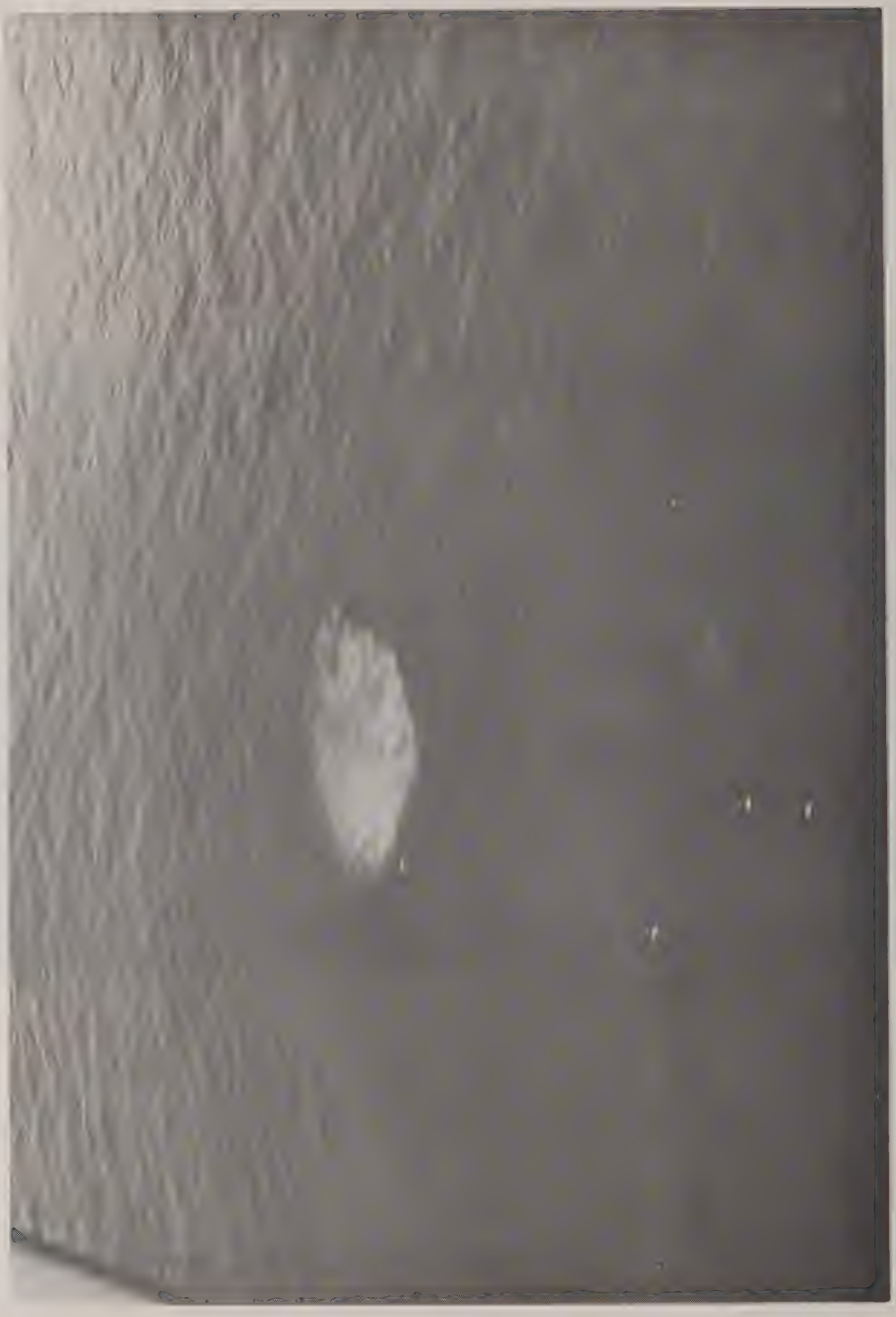


PLATE 26

'INSTANT BOILING' OF KAHAWAI.

PLATE 27

KAHAWAI 'BREEZING' AFTER BEING 'CHUMMED' FROM THF AIR. (PATEA)

PLATE 28

LARGE SCHOOL TREVALLY AND SMALL SCHOOL OF SKIPJACK 'BREEZING' AFTER BEING 'CHUMMED' FROM THE AIR. (PATEA)

PLATE 29

23 TO 25 SCHOOLS OF KAHAWAI, MACKEREL AND SKIPJACK, 8 MILES SOUTH OF WANGANUI.

PLATE 30

MAIN SCHOOL COMPRISING OF MACKEREL AND KAHAWAI WITH SCHOOL OF SOUTHERN BLUEFIN WORKING BELOW MAIN SCHOOL.

PLATE 31

MAIN SCHOOL IN NET - SOUTHERN BLUEFIN ESCAPING BELOW FAR END OF THE NET.

PLATE 32

MAIN SCHOOL PURSED - NOTE IRIDESCENT REFLECTION FROM MACKEREL.

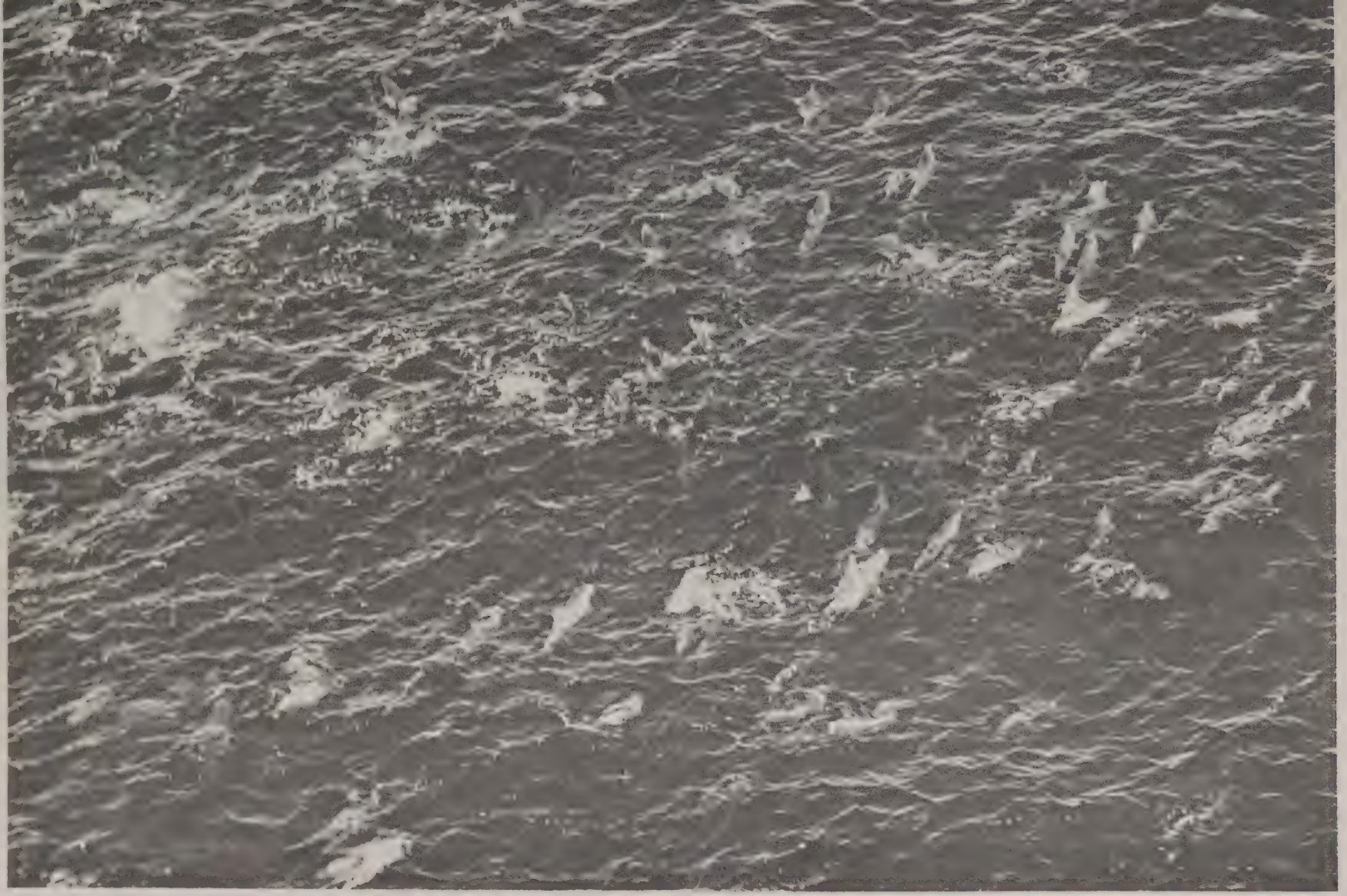


PLATE 33 COMMON DOLPHINS Delphinus delphis.

All identification doubts regardin g kahawai can be dispelled by flying at a fairly low altitude over the school and observing the very flexible wriggle of the tail compared to all other pelagic species in New Zealand waters; these schools are often termed 'wrigglers'.

Trevally

Plate 28 illustrates the uneven 'boiling' or 'foaming' of trevally. This species can invariably be identified by the light reflection on the silver body even under cloudy sky conditions. Very often the school is obscured by hundreds of terns (Sterna striata) particularly when the bait is close to the surface and the terns have no need to make a high dive to reach the bait. If trevally are spotted near the surface the whole school sometimes appears to have a dark green colour, when the fish are schooling in shallow water.

Jack Mackerel

This species (Trachurus norawzelandiae) has a sandy/brown appearance when in coastal green waters and deeper brown tinged with slight red when seen in coastal blue waters. Depending on the amount of cloud cover or sunlight the sandy colouring can take on a faint green/yellow in addition. The schooling pattern is very regular as this species is not as 'scarey' or 'spookey' when actively feeding. There is no 'fold' as found in skipjack schools and the 'foaming' period is much slower than that of kahawai. Although the jack mackerel will feed just below the surface the school does not appear as the heavy 'ripple' seen in albacore schools. A school will sometimes maintain two foaming centres (see school in circle on Plate 29) and usually remains as such, making this species fairly easy for purse seining.

Under overcast cloud conditions or in coastal blue waters the jack mackerel appear similar to kahawai with a blue/brown colouring, but if the spotter is in any doubt, a low altitude observation will show that the mackerel has a 'firmer' swimming motion than the typical kahawai 'wrigglers'.

English Mackerel

The colour of the schools can vary markedly under various water and sky conditions. In clear sunlight this species reflects a vivid iridescent green as the fish feed or are disturbed. Although Plate 32 is not in colour the reflection from this species can be seen just clear of the 'bunched' section of the cork line. Under overcast cloud conditions or in coastal blue water the jack mackerel appear similar to kahawai with a blue/brown colouring, but if the spotter is in any doubt, a low altitude observation will show that the mackerel has a very 'firmer' swimming motion than the typical kahawai 'wrigglers'.

Anchovy (Engraulis australis)

This species is easily recognised by the tightly bunched schooling behaviour. A close up view can be seen in Plate 8; under most light conditions the round shaped schools have a brown colour, and are known in most countries as 'meat balls'. When attacked the anchovy often break surface with the appearance of a high power water hose being played on the surface of the sea.

Pilchard (Sardinops neopilchardus)

From observations in the Gisborne, Tasman Bay and Bay of Islands areas (marked 1, 3 and 3 respectively in Figure 1), pilchards appear as long slim ripples on the surface. However, only on one occasion have they been seen by the author to 'boil' and that was off Gable End Foreland (in the Gisborne area) when large schools of albacore were driving the pilchards to the surface; under these conditions the schools were similar to anchovies breaking the surface.

Other species easily recognisable from the air, but of less commercial value are the blue maomao (Scorpis aequipinnis) and the warehou (Seriolella brama). The former is mainly identified by the light blue/violet colouring that shows from the air as very distinctive streaks, especially when the maomao is close inshore. The warehou appear as black spots tinged with faint yellow at low altitudes. At heights of over 400 metres large schools of warehou that are surface feeding appear as 'flashers' as this species feeds with the dorsal surface clear of the water. Other terms used by not mentioned above include:

'Fireball' - a common effect when tuna disturb luminescent plankton.
'Popper' - a burst of phosphoresence by individual fish.
'White bellies' - schooling and feeding dolphins or porpoises.

(e) Hydrology

1. General

The main factors in the area influencing temperatures and salinities were the possible transport of sub-tropical water via the East Auckland Current (Figure 1b), and low salinity water from rivers and general 'run off'.

2. 1969 Season

The possible relationship between the presence of skipjack and salinity values close to 34.7‰ (Seckel & Waldron, 1960, York, 1969) can be seen from Table A for February and March. Out of 24 occasions when salinities were measured during fishing operations 15 readings were either 34.7‰ or 34.8‰, and except for a large catch of albacore on March 14, all landings over 500 kg were in this narrow salinity range.

Surface temperatures remained stable during February and March, averaging 19.9°C and 19.8°C respectively, but by April 26 continual winds between south and west lowered the surface temperature below 16°C.

3. 1969/70 Season

January

This month's surface temperatures were extremely high, the maximum at 24.6°C and the average 23.1°C. The evidence of air spotting (Page) indicated that during these high surface temperatures the albacore only rose to feed for short periods and then sounded to 30 or 40 metres. Albacore were seen in good quantities at this depth on the fish-finder. Also, vertical temperature profiles revealed a sharp thermocline at about 400 metres. Whenever the "Trade Wind" anchored at White Island albacore were invariable caught on trolling lines approximately one hour before dawn, and several hours before solar radiation had any marked effect on the surface water. Conversely catches were made up to two hours after sunset when again the surface water had cooled considerably.

During the same period good catches were landed off New Plymouth on the west coast, the average temperatures in this area being around 19.0°C; temperatures observed in the same area in the summer of 1962 averaged 22.5°C and the only tuna sighted were skipjack in an area under the influence of cool fresh water from the Manakau Harbour (Figure 1).

February

High temperatures continued this month. The maximum recorded temperature was 23.5°C, minimum 21.8°C and average 22.8°C. The normal good February schools of albacore were not in evidence, but the skipjack moved closer inshore to cooler areas several km off river mouths. In these regions 6,654 skipjack were landed with only 56 albacore, 10 northern bluefin and 32 yellowfin. Vessels making reasonable catches of skipjack were fishing in waters of 34.7% as recorded by the F.V. "Stranger"; the only vessel taking hydrological data.

March

Temperatures continued to remain stable and high for March, the average being 21.8°C, maximum 23.1°C and minimum 20.3°C, again the best catches were made in the same narrow salinity band as for February.

April

Hydrological measurements were only recorded for the first week of April when surface temperatures were still fairly high; the best catch of skipjack were once more found in salinities of 34.7% and 34.8%.

(f) Sub-Population Studies

Initially, blood sampling was tried at sea as soon as the skipjack were landed, but the motion on small 'day boats' caused the hypodermic needle to often miss the crucial point of entry into the heart, as a result most of the sampling was carried out either in calm waters or as soon as the skipjack arrived at the fish shed.

Dr K. Fujino of the Bureau of Commercial Fisheries, Hawaii, found that the gene frequencies of serum esterase system of the blood samples (Tables B1, B2 and B3) were indistinguishable from fish of the western Pacific sub-population (Fujino, 1970a). Fujino also states that "The boundary between the western Pacific sub-population and estern Pacific population(s) may be found between New Guinea-Australia and the date line, somewhere near the New Hebrides, the Loyalty Islands, and the west coast of New Zealand. It is likely that seasonal boundary shifts analogous to those in the Northern Hemisphere take place, although no data are available yet. (Fujino, 1970a).

The length/frequencies, sex ratio and general gut contents are shown in Figure and Tables B1, B2 and B3.

TABLE B1

Species	Date	Length	Sex	State of Gonad
Skipjack	8.4.70	53 cms	M	Immature
"	"	51	M	"
"	"	61	M	Ripening (early stage)
"	"	59	M	" " "
"	"	60	M	" " "
"	"	47	F	Immature
"	"	59	M	Ripening (early stage)
"	"	54	M	Immature
"	"	57	M	"
"	"	58	M	"
"	"	51	F	"
"	"	49	M	"
"	"	48	M	"
"	"	51	M	"
"	"	52	F	"
"	"	49	F	"
"	"	48	M	"
"	"	51	M	"
"	"	48	F	"
"	"	50	M	"
"	"	50	F	"

Stomach contents:- Mainly pilchards (Sardinops neopilchardus) and anchovies (Engraulis australis) with small percentage of Euphausid spp.

TABLE B2

Specie	Date	Length	Sex	State of Gonad
Skipjack	9.4.70	57 cms	M	Immature
"	"	50	M	"
"	"	56	F	"
"	"	51	F	"
"	"	49	?	
"	"	49	F	Immature
"	"	51	M	"
"	"	52	F	"
"	"	55	M	"
"	"	55	F	Ripening (Early stage)
"	"	57	M	" " "
"	"	51	F	Immature
"	"	49	F	"
"	"	49	F	"
"	"	51	F	"
"	"	51	?	
"	"	53	M	Immature
"	"	54	F	"
"	"	49	M	"
"	"	51	M	"

Stomach contents predominantly Engraulis australis.

TABLE B3

Specie	Date	Length	Sex	State of Gonad
Skipjack	9.4.70	54 cms	M	Immature
"	"	55	M	"
"	"	53	F	Ripening (very early stage)
"	"	49	F	" " " "
"	"	51	M	Immature
"	"	48	F	"
"	"	50	F	"
"	"	50	F	"
"	"	53	F	Ripening (very early stage)
"	"	50	M	Immature
"	"	50	F	"
"	"	52	M	"
"	"	55	M	?
"	"	54	M	Immature
"	"	52	F	Ripening (very early stage)
"	"	54	M	Immature
"	"	54	F	Ripening (very early stage)
"	"	56	F	" " " "
"	"	53	F	" " " "
"	"	55	M	" " " "

Stomach contents:- Sardinops neopilchardus and Engraulis australis.

(g) Revised Fishing Rechniques

General

During the programme in the Bay of Plenty the hydrological conditions were often different from those experienced in the East Coast area (York 1969), subsequently the behaviour pattern of the tuna was occasionally different which led to some modifications of previous catching techniques.

1. Trolling

When trolling in the White Island area in January 1970 high surface temperatures kept the albacore beyond the depth range of trolling lures and diving paravanes, and the fish would only rise in small schools for short periods (see page 7). It was found that if the vessel's speed was reduced to approximately 2 knots the small schools would surface and start to strike two or three lures; when this occurred the vessel was stopped and as the albacore were being landed one crew member would slowly haul in the 'empty' lines and the 'teasers', invariably some of the school would follow the general rise and strike the empty lures.

Trolling for skipjack was not successful until the vessel's speed was increased to between 8 and 10 knots and the shock absorber altered as in Figure 3a with a long and light sandow line. Observations on the effect of various coloured lures showed a marked increase on the catch rate (between 25 and 33%) when dark brown and green lures with small streaks of light yellow or white, were towed during overcast conditions, at dawn and just before sunset; predominantly light coloured lures with streaks of dark brown and green were best suited for bright conditions.

Figures 3a and 3b illustrate simple and inexpensive lures which can be made in a large variety of colour combinations.

During gill-netting operations ((g)(2)) J. Plewse, owner/skipper of F.V. "Comrade" was chumming a gill-net and also using dead bait on the barbless hook of a trolling lure, casting overboard and allowing it to sink below the gill-net and slowly hauling the baited hook back inboard; this type of fishing yielded catches as high as 400 kgs/hour, although the catch rate was not as consistently high as other methods every tuna landed supplemented the gill-net catch.

2. Gill-netting

The previous method of gill-netting using five nets (York, 1969, 1971) was found to be too slow and arduous for small vessels with a limited number of crew. Very often the skipjack would 'foam' on the surface for short periods and would sound before the full fleet of five nets were streamed.

Furthermore if the short was not successful it took 15 minutes to haul in five nets, whereas two men can haul one in 4½ minutes and be ready for another 'shot'. Therefore, the following revised method was followed: The net stowed at the stern of the boat (Figure 6) had the cork line on the port side, with a marker buoy and large float on the outboard end and a 55/60 metre line on the inboard and secured to the stern of the boat. The 'lead' or 'ground' line on the starboard side had extra weights (approximately 2-3 kg) either end to help the net to sink and set quickly. Upon sighting a school such as that shown in Plate 34 and Plate 15 the vessel approached at a steady speed (up to 8 kts) without any alteration of revolutions.

The engines were 'cut' as the net was streamed ahead of the school; after a few practice 'runs' the skippers soon gauged the correct time to shoot so that the net was fully streamed and the vessel had 'lost way' by the time the 55/60 metre line was streamed. In most cases the cork line would sink within minutes of the tuna striking the net, but sometimes feeding aggregations of birds and tuna species remained static for long periods (Plates 35 and 36). Under these conditions precautions against acoustic abberations disturbing the school are not important, the net could be streamed straight through the school which would briefly part and then 'gill' on both sides of the net. The best catch on a single gill net was made under these conditions (Plate 37). When retrieving the net the engine was left 'idling' and out of gear. The line attached to the cork line was heaved in until the vessel lay astern to wind, the cork and lead lines were then hauled in on each quarter with the belly of the net in between. The fish were unmeshed (Figure 6, and Plates 2 and 38) as the cork and lead lines were heaved in together and the engine was only used if the wind or tide put a strain on thenet, after ascertaining that the belly was not billowing or drifting near the propeller(s). During the 1969/70 programme approximately 300 kgs of anchovies taken by a small dip net from a dingy (see Plates 8 and 9) and distributed among the commercial vessels and used to chum the nets. As there was no facilities to keep the anchovies alive all chumming was carried out with dead bait which increased the catch rate in the region of 25%.

Plate 14 shows a dense school of anchovies being chased toward the surface by skipjack which broke surface in the vicinity of the F.V. "Takapu" forming five or six meatballs; later in the season a dinghy from F.V. "Stranger" slowly rosed amongst several meatballs of anchovies which immediately swam under the dinghy in a clockwise direction apparently for shelter from

predators, and remained under the boat which was slowly rowed over to a streamed gill-net followed by a small school of skipjack which swam into the net, yielding a catch of 562 kgs (see Table 14, March 23).

It was often frustrating to the fishermen when they shot a net around a school of tuna only to find a small proportion of the school had hit the net and the bulk of the school remained on the surface within a few metres of the cork line; a high speed launch "Sea-Hunter" was loaned to the Author by Hamil Bros of Whakatane to herd to skipjack using the technique of approaching the school at a steady slow speed and suddenly putting the engine out of gear when close to the skipjack and at the same time accelerating the engine. This action had a marked scaring effect and invariably the skipjack sounded in the direction of the net; the net could be seen to partially sink and when brought inboard most of the skipjack were meshed on the lower part of the 150 mesh deep net.

3. Long Lining

Long lining from small vessels using conventional Japanese gear presented problems, the main being the lack of space to stow several baskets each containing 5 snoods spaced along a 55 metre main line; a modified line was devised (Figure 5) which was basically a bottom shark line (York 1970a) buoyed and set with 5 fathom drop lines to allow the line to fish between 7½ and 10 fathoms. (York 1971:1975). Two sets were made in 25 metres close to the Valker Island (3 miles north west of White Island) and only six yellow-tail (Seriola grandis) were landed: a further attempt was made after ascertaining from echograms that a school of albacore were in evidence 26 metres below the surface between White Island and the Valker Islands. The long line streamed over the stern of the "Trade Wind" in a ½ knot current with a groper buoy on the outboard end for 30 minutes, after which the line was hauled in (Plate 4) and five albacore averaging 18 kgs were landed. No catch data was entered in Tables 1-24 as this was the only vessel fitted with complete long linging equipment, but the hook rate was 5 per 100 hooks and 90 kgs per 100 hooks, or 10 fish/180 kg per 100 hook hours. The bait used for this experiment was partially decomposed anchovies tied on the hooks with cotton.

4. Live/dead bait and Pole Lining

The first attempt at poling using conventional gear (Sampson 1962) with Japanese skipjack jigs was made from F.V. "Stranger"; a small school was approached at a steady 3 knots and slowly circled while a crew member chummed 3 or 4 anchovies at a time, as soon as the tuna showed interest and started to take the bait fish, two members thrashed the surface hard with the pole and jigs. Because of the inexperience of the crew only 23 skipjack were landed, but this early attempt led to subsequent increases in poling from small vessels. Messrs A. Killion and A. Campbell originally from the U.S.A. greatly assisted Fisheries Management Officers to master poling techniques from F.V. "Pirimai" during the 1970/71 season. At the time of writing, it is worthy of note that some skippers tuna fishing from Whakatane have evolved a unique poling technique using mainly dead bait from small vessels manned only themselves.

5. Purse Seining

Although purse seining in its modern concept using a Puretic Power Block was first attempted in 1965 at Tauranga by the Union Fish and Ice Coy Ltd (J. Costello), it was the Fisheries Management Division's dual Seiner/ Trawler the "W.J. Scott" that landed commercial quantities of pelagic fish in the Gisborne area and also helped to train several of Gisbornes local fishing skippers in the art of purse seining during 1967; the only difference in methodology was the use of a large buoy instead of the conventional skiff used by the "W.J. Scott" and the U.S.A. seiner "Esperito D'Santo" in 1971 (see page 9).

6. Acoustics

On two occasions skipjack was detected by sono buoys at a distance of two miles, the main sound recorded being a combination of anchovies foaming and swimming signals from skipjack in the form of a "knocking" sound; the latter recorded by several overseas units under laboratory conditions. On these occasions the schools were approached at 4 knots and 17 fish were landed. (Table A March 20).

(h) Catch Results

1. General

No valid conclusions can be made on the effectiveness of trolling for summer of he 1968/69 season as only on March 14 1969 (Table A) was any effort made to land tuna by this method; the catch rate in Table A included the many hours of searching, time taken for hydrological measurements and acoustic experiments; the highlights of the fishing effort can be summarised as follows:-

Number and weight of fish from combined gill-netting and trolling - 1,340

Gill-netting catch rate for March:-

Total weight of skipjack	4,273 kilos
Total number of skipjack	1,125
Average weight	3.8 kilos
Number of gill nets set (one net per set)	15
Numbers of hours fishing	18.4
Net hours	18.4
Number of skipjack per hour	61
Weight of skipjack per hour	232 kilos
Number of skipjack per net	75
Weight of skipjack per	286 kilos

Weight of fish caught (combined gill net and trolling).
In the 1969/70 season Tables 1-24 show that a total of 16,515 tuna weighing 66,268 kilos was landed at the Port of Whakatane.

The catch by species/by month were as follows:

Month	Skipjack	Albacore	Yellowfin	Northern Bluefin
January	472	1,111	9	13
February	6,646	281	43	9
March	5,201	114	44	
April	2,539	2	31	

Table 25

Wind Velocity - January to April 1970

January	
1st to 6th	NWly 5 - 10 kts
7th	NNWly 35 kts
8th to 9th	Nly 10 - 30 kts
11th	Nly 10 kts
12th	Sly 27 kts
13th - 15th	NWly 20 - 35 kts
16th	NWly 15 kts
18th - 19th	NEly 10 - 12 kts
20th - 31st	NWly 5 - 17 kts
February	
1st - 18th	N/NWly 5 - 17 kts
19th	NWly 20 kts
20th - 28th	N/NWly 5 - 20 kts
March	
1st	NWly Gale
2nd	NWly 20 kts
3rd - 11th	NWly 5 - 17 kts
12th - 17th	N/NWly 10 - 17 kts
18th - 22nd	NE.E 10 - 25 kts
23rd - 24th	Lt. Airs
25th - 31st	N/Nely 5 - 25 kts
April	
1st - 6th	NEly 20 - 35 kts
7th - 8th	Nly 5 - 22 kts
9th - 11th	S/SWly 25 - 35 kts
11th - 25th	N/NWly 5 - 17 kts

2. Effect of Weather

Fishermen in the central and eastern sectors of the Bay of Plenty have experienced low catch rates for demersal and pelagic fish when ever the wind direction had an easterly component, commercial fishermen often refer to this phenomena as the "Hungry Wind". Table A shows this effect within the period February 23rd to 25th when only 10 tuna were landed, and low catch rates are shown on January 18th and 19th in Table 2, March 18th and 19th in Table 13, and Tables 22 and 23 for the period April 1st to 6th. Wind direction changes from the south through to north east are usually rapid and this could cause a wind-upwelling effect causing temporary nutrient depletion similar to upwelling areas off the New South Wales coast. (Bulleid & D.J. Carpenter 1972).

Since revising the methodology for gill-netting from small boats it is not advisable to haul nets by hand in winds over 17 kts because it is too strenuous to, haul a net by hand stern to wind, whereas 22 to 24 kts appeared to be the comfortable maximum for most vessels. The optimum conditions for poling varied for each vessel as each hull acts differently to wind resistance, i.e. some boats will remain 'head to wind' others will 'fall off' the wind and 'sail' beam on in a very short period. The method that can be used in

all conditions that the vessel remains operable is long lining as the line is hauled whilst steaming in to the wind.

The mount of cloud cover influenced the colour combination of trolling and poling lures (g) section (1).

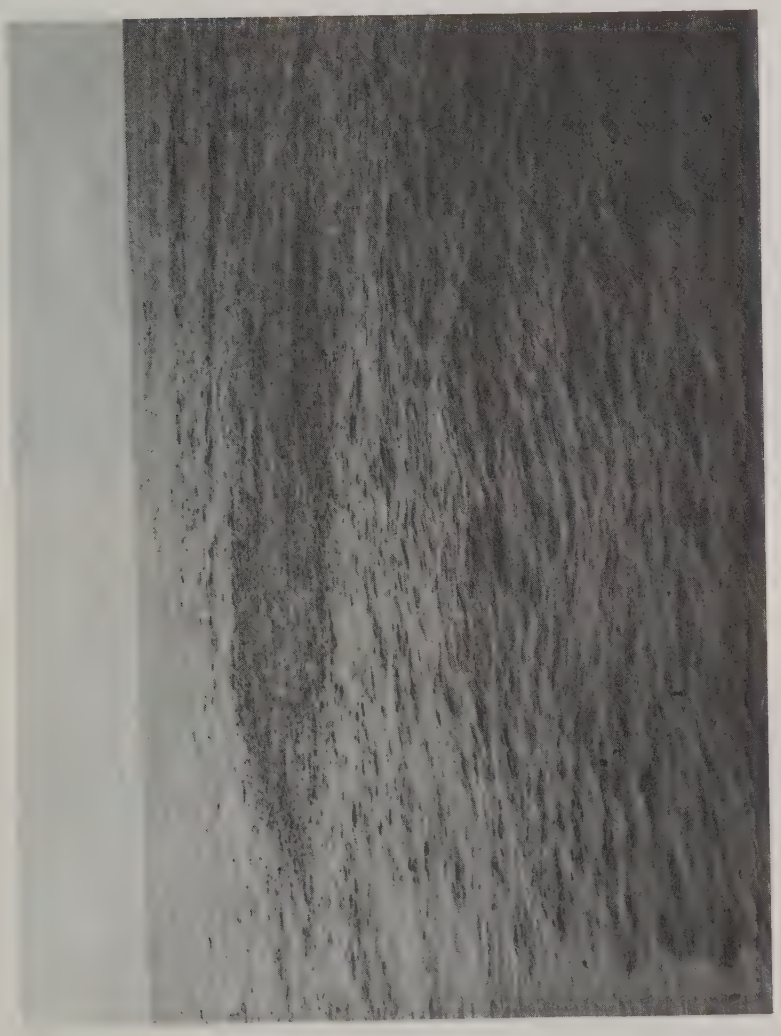


PLATE 34

MIXED SCHOOL OF ALBACORE AND SKIPJACK FEEDING ON ANCHOVY.

PLATE 35

FEEDING AGGREGATION OF GANNETS, SHEARWATERS AND ALBACORE.

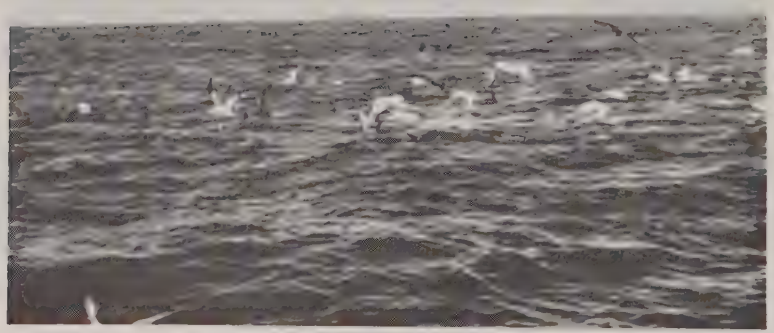


PLATE 36

FEEDING AGGREGATION OF GANNETS, SHEARWATERS, JUVENILE YELLOWFIN AND SKIPJACK.

PLATE 37 APPROXIMATELY 1400 kg SKIPJACK GILLNETTED IN TWO MINUTES.

PLATE 38 UNMESHING SKIPJACK.

(i) Size Range

1. General

The histograms on Figures 7-12 represent the fork length (to the nearest centimetre) of 3,069 skipjack, 550 albacore and 13 yellowfin.

Growth curves from the eastern Pacific (Joseph and Calkins 1969) suggest that skipjack in the New Zealand region could be in the first year age group with a modal length of 34 centimentres and a monthly growth increment between 1.75 and 2.00 centimentres, the annual growth being approximately 21 centimentres.

2. Length Composition

Figure 7 shows two major modes of skipjack in March 1969 at 55 and 58 centimetres, and a minor mode at 63 centimentres; the size range was between 51 and 64 centimentres. The albacore sampled formed four minor modes at 58, 62, 68 and 72 centimetres, with a size range from 48 to 72 centimetres. In the following March (Figure 10) the skipjack entered the fishery in a major modal group of 50 centimetres, about 2 years old with a second major mode at 56 centimetres in the 2½ year age group. Because of the small numbers of albacore sampled in March 1970 only one minor mode at 50 centimentres appears in Figure 10 denoting two year old fish and a size range from 39 to 61 centimetres.

It is apparent from the length frequency distribution illustrated on Figures 8-12 that there is little evidence of a shift in modal lengths due to montly growth increment, and the irregular pattern of modal groups per month could be the effect of hydrological changes in the inshore region of the fishery and the availability of different types of food. It was observed in the 1970 season that the predominant gut content from skipjack was anchovies (Engraulis australis) ranging in length from 76 to 100 millimetres forming the diet of all age groups sampled, but in the following season the live bait vessel F.V."Pirimai" could not pole skipjack in 38 to 53 centimetre length range with large anchovies with a major mode of 152 to 180 millimetres.

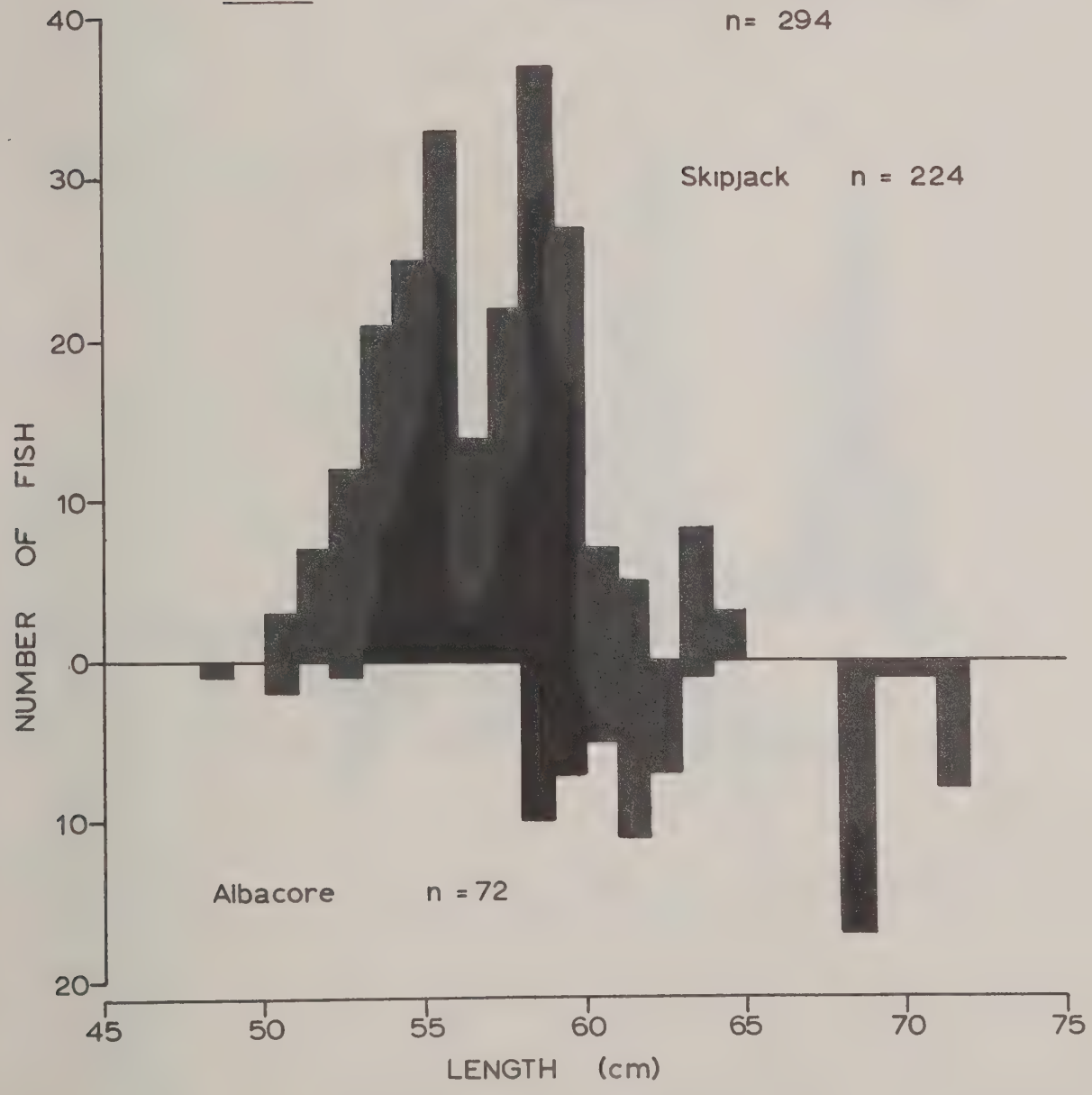
Table 26 summarises the shifts in monthly size ranges from January to April 1970.

TABLE 26 Skipjack

Month	Major Mode	Minor Mode	Size Range	From	To
January	50 cm	61 cm		47 cm	70 cm
February	61 cm			46 cm	69 cm
March	49 & 56 cm			42 cm	67 cm
April	47 & 54 cm			46 cm	57 cm
	Albacore				
January	79 cm			46 cm	97 cm
February	64 cm			46 cm	69 cm
March		51 cm		39 cm	61 cm

The sampling of only 13 yellowfin was not considered sufficient for length composition data.

FIG. 7 LENGTH FREQUENCY — MARCH 1969



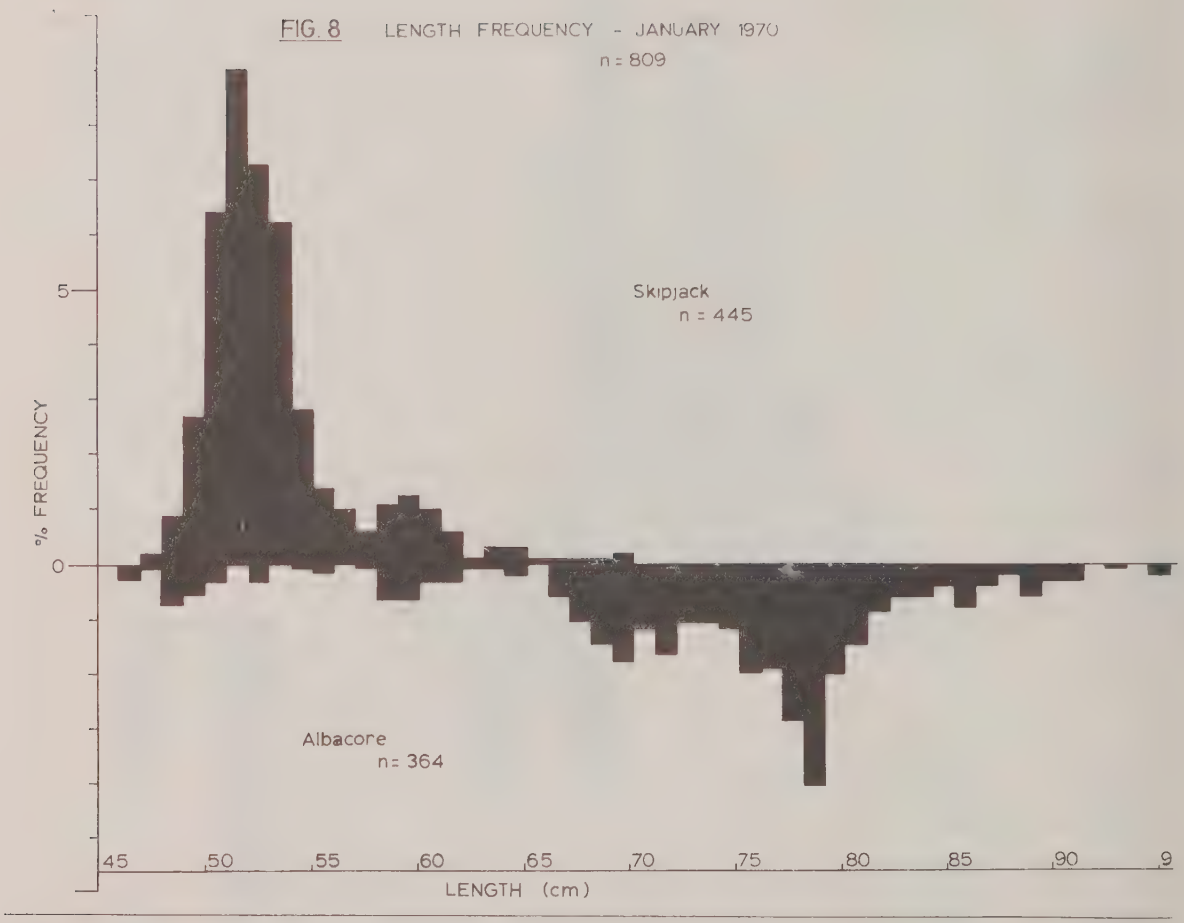


FIG. 8 LENGTH FREQUENCY - JANUARY 1970
n = 809
Skipjack
n = 445
Albacore
n = 364
% FREQUENCY
5
0
45
50
55
60
65
70
75
80
85
90
9
LENGTH (cm)

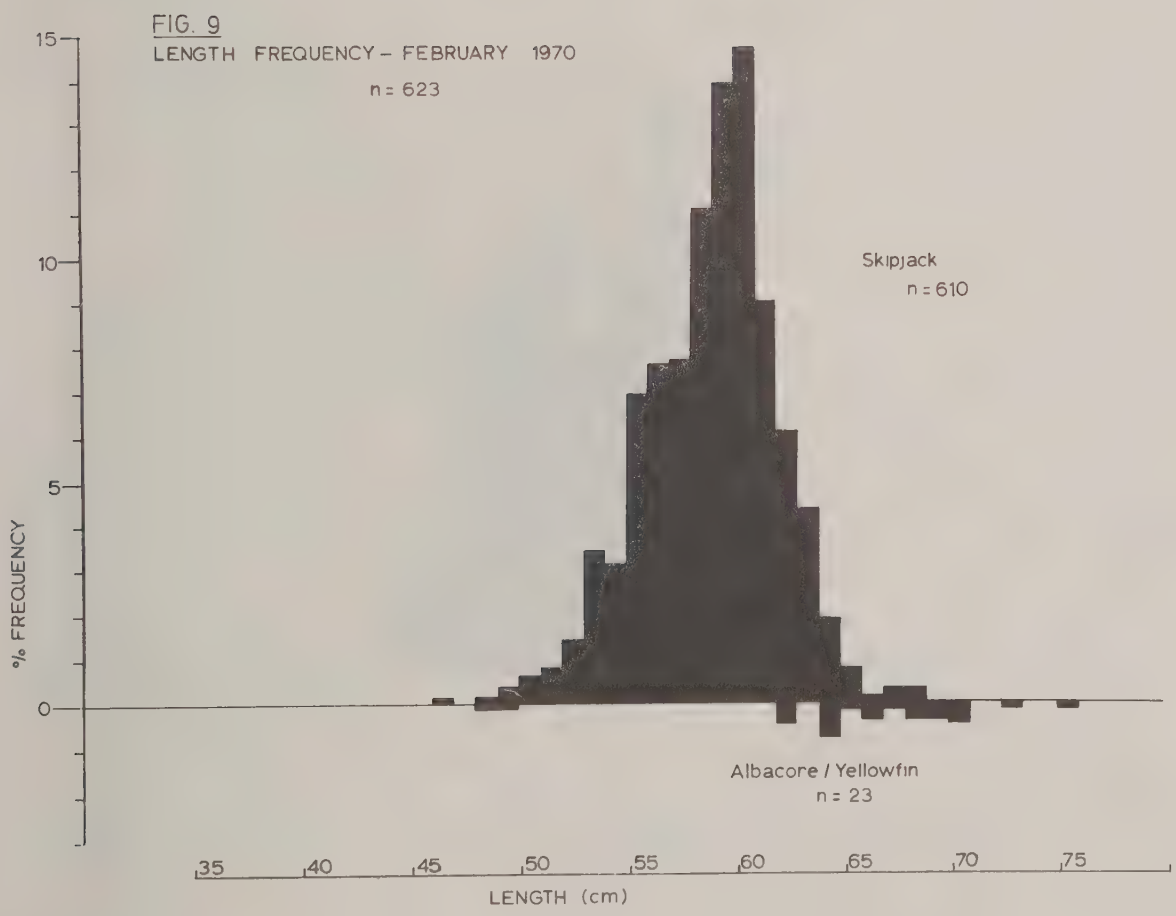


FIG. 9
LENGTH FREQUENCY – FEBRUARY 1970
n = 623
15
10
5
0
% FREQUENCY
Skipjack
n = 610
Albacore / Yellowfin
n = 23
35
40
45
50
55
60
65
70
75
LENGTH (cm)

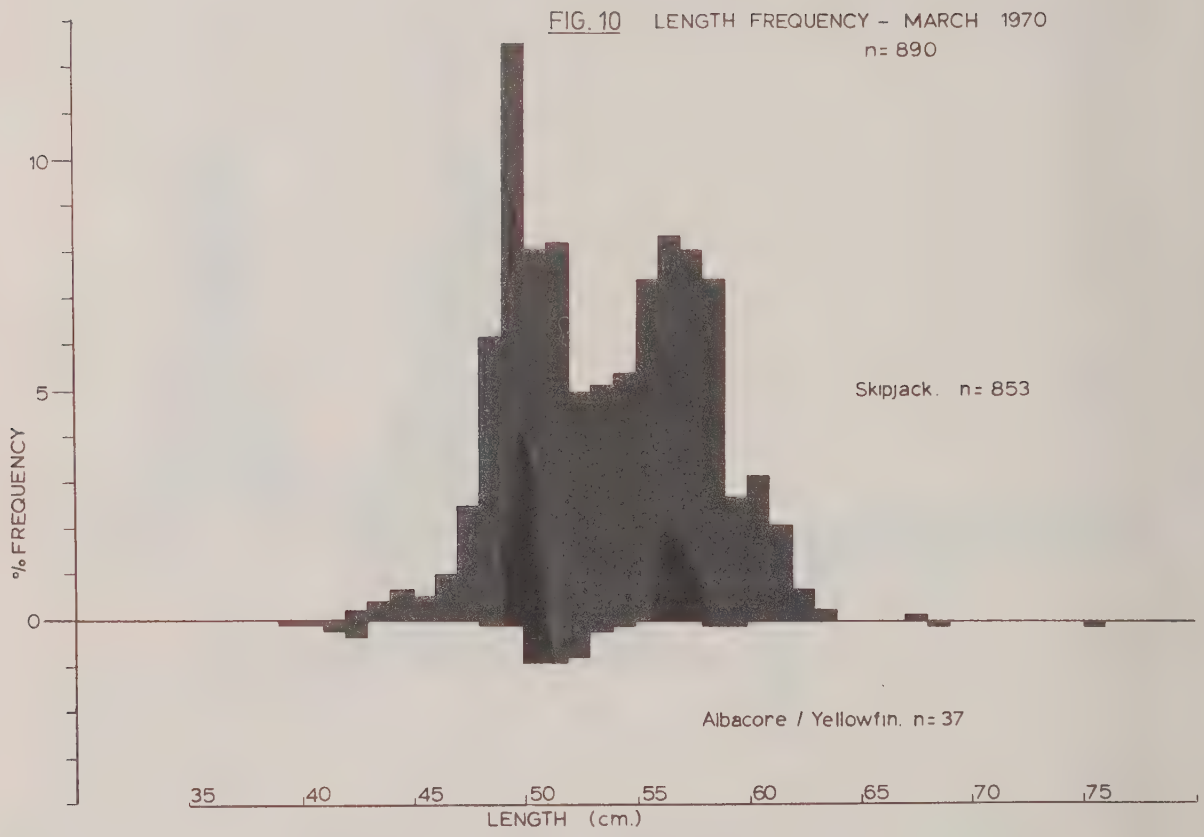
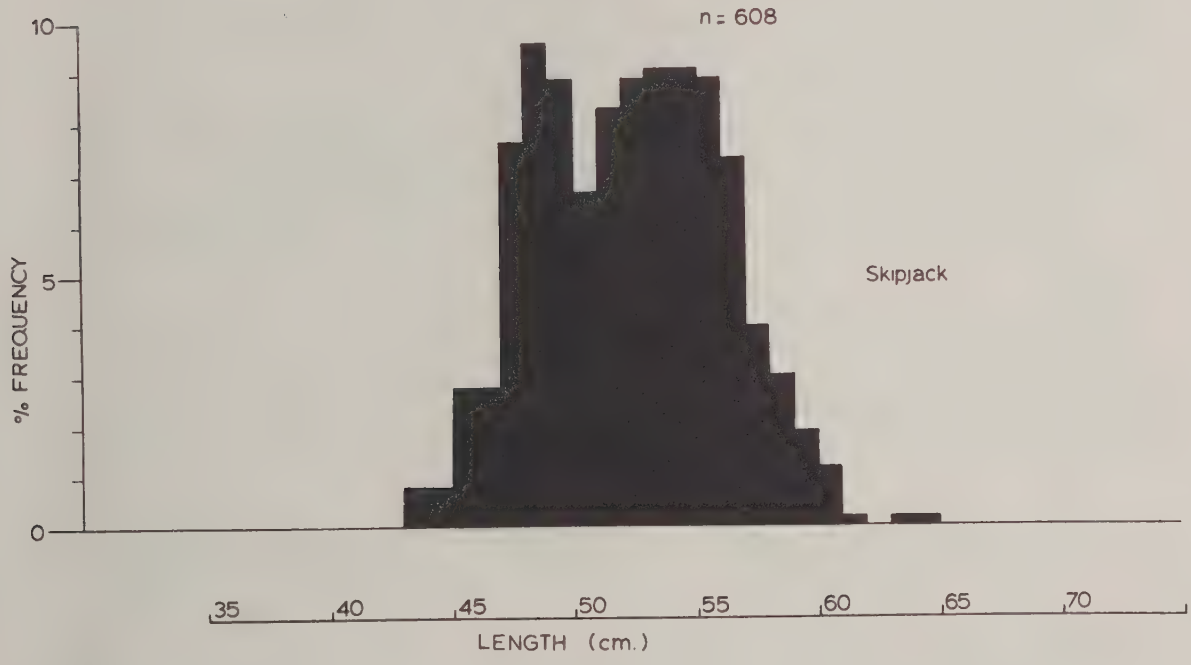


FIG. 10 LENGTH FREQUENCY - MARCH 1970
n= 890
10
5
0
% FREQUENCY
Skipjack. n= 853
Albacore / Yellowfin. n= 37
35
40
45
50
55
60
65
70
75
LENGTH (cm.)

FIG. 11 LENGTH FREQUENCY – APRIL 1970



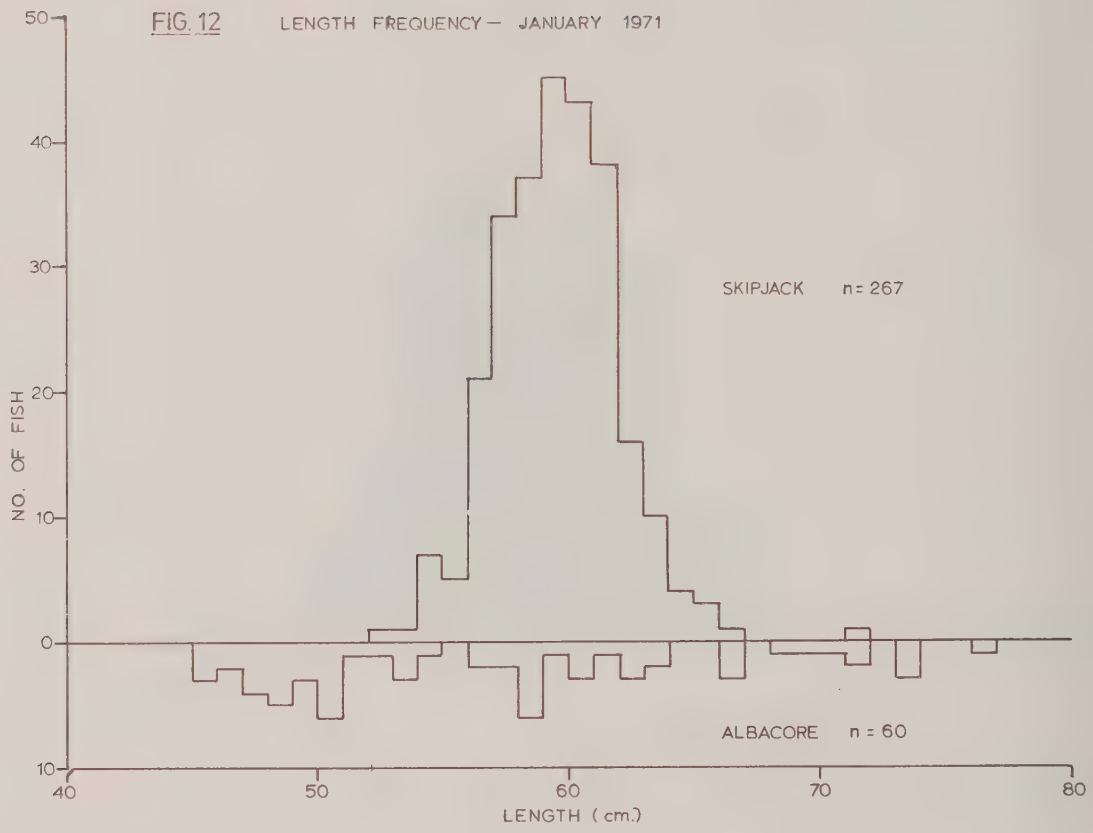


FIG. 12
LENGTH FREQUENCY — JANUARY 1971
SKIPJACK n= 267
ALBACORE n = 60
NO. OF FISH
LENGTH (cm.)
50
40
30
20
10
0
10
40
50
60
70
80

(j) Species Identification

The author examined four species of Thunnus tonggol (Bleeker, 1851) landed by members of the Whakatane Big Game Club, the salient feature differences being the absence of swimblader and the gill-raker count lower than other Thunnus species; the fork lengths were between 80 and 95 centimetres. Advice on future identification was given to the club eventuating in the report of a further 18 T. tonggol landed by members of the club.

(k) Conclusions

The introduction of poling from small vessels will probably become the main method for future tuna fishing in this area as the fish do actively respond to dead bait chumming in the inshore areas (between Whale Island and White Island) also the vessels unlike purse seiners, are not restricted to an operational depth; the fishing gear is relatively cheap compared to that for trolling, and much cheaper than nets for gill-netting, and bait fish appeared to be in reasonable supply for most of the tuna fishing season.

The experimentation with varying coloured lures increased the catch effort for trolling particularly with skipjack, this aspect of trolling should help fishermen when standard lures such as hexheads, feather and ruby-eye etc. do not appear to attract the tuna.

The method of gill-netting was responsible for landing the majority of skipjack, the use of only one net (section g(2)) streamed at about 9 kts greatly reduced the fishing time involved in previous methods (York 1969) and also the expense of operating five nets. There is a possibility that long lining could increase the catch rate for albacore during the short periods when the surface temperatures are above normal and the tuna remain in the cooler water layers.

Toward the end of the survey several vessels were rigged for gill-netting, poling and trolling, using the appropriate method to suit the behaviour of the tuna; if the tuna were schooling in tight surface schools poling or netting took preference, but when the fish were scattered over a wide area then trolling became the prime method. This diversity of methods would give the fishermen every opportunity to exploit the tuna under varying behavioural schooling patterns.

In order to evaluate the general recruitment of the inshore fishery as many length measurements as possible should be taken in view of the anomolies encountered for normal monthly growth increment discussed in section (i).

Future acoustic studies should concentrate more on the effects of unwanted noises caused by loose fittings, sloppy bearings, varying shaped hulls etc, and also in the field of long range detection of tuna schools by sonobuoys.

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I am grateful to Mr B.T. Cunningham, Director, Fisheries Management Division, for approving and assisting in planning the acoustic survey of 1968 to 1969, and subsequent programmes to 1971. I am also grateful to the Hon. A. McCready, Minister for Marine for his enthusiasm of the project when visiting the Whakatane Big Game Club during the programme. Special mention to D. Jellyman, D.T. Williamson and I. McMillan for their assistance in the field work. Thanks also to my colleagues of the Fisheries Management Division Messrs B. Brun, R.D. Cooper and I. Clements for editing the manuscript.

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SUMMARY OF INVESTIGATIONS CARRIED OUT FROM F.V. "TAKUTU" - SUMMER 1969

GN = Gill-Netting
F = Fishing
N = Nets (by number)
TR = Trolling
H = Hydrology
A = Acoustics
S = Searching
LL = Long Lining
L = Lures (by number)

						NOON						CATCH							
												BY NUMBER OF FISH					BY WEIGHT		
Day	Weather	Type of Investigation	Area	Depth in Metres	Colour	Average Temperature °C	Average Salinity °/oo	Method	No. of Nets or Lures	Fishing Time	Hook or Net Hours	Skipjack	Albacore	Yellowfin	Fish per hook or net hour	Fish per F	Kg per Hook or Net Hour	Kg per Hour	Total Weight kg
20	SLY 22KTS	H	-	-	-	19.8	34.8	-	-	Whakatane to 8 miles north of Whale Island.							-	-	-
21	SSW 10	H & S	-	-	-	20.1	34.8	-	-	Whakatane to 4½ miles north of Whale Island							-	-	-
22	SLY 12-15	S & F	Q25	91	7/8B	-	-	GN	2N	1.3	2.6	10	-	-	3.9	7.7	17.7	35	45.5
23	SE 30	H & S	-	-	-	19.6	34.9	-	-	Whakatane to 4 miles north of Chiwa.							-	-	-
24	ESE 17-22	H & S	-	-	-	20.0	34.7	-	-	Whakatane to 8 miles north of Whale Island.							-	-	-
25	ESE 17-22	H & S	R26	95	-	20.0	34.7	TR	6L	-	-	7	3	1	-	-	-	-	59
26	NLY 10	H,S & A	R27	94	-	19.7	35.0	TR	6L	-	-	9	1	-	-	-	-	-	41
27	LT-VAR	H S & A	P31	110	5/8B	20.1	34.7	TR	6L	-	-	11	24	1	-	-	-	-	136
28	NNW 15-20	S F & A	P31	110	7/8B	19.9	34.8	GN	1N	1.5	1.5	31	4	-	23.3	23.3	91.4	91.4	136.4
TOTAL																			418.3
AVERAGE						19.9													
																MARCH			
1	NW 50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	NW 35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	SW 17	H & C	-	-	-	19.7	35.0	-	-	In vicinity of Whale Island					-	-	-	-	-
4	LT.VAR	F H & A	N25	110	7/8B	20.0	34.7	GN	5N	4.0	20.0	262	-	-	13.1	65.5	36.9	184.5	738
5	LT.VAR	F H & A	N25	110	8/8B	19.8	34.7	GN	4N	5.9	23.6	248	1	-	10.5	41.0	34.9	139.4	823
6	WLY 17	F H & A	T25	37	5/8G	19.7	34.7	GN	3N	5.8	17.4	55	-	-	3.2	9.5	13.5	40.2	233
7	WLY 25	F H & A	T25	40	5/8G	19.7	34.7	GN	2N	1.8	3.6	21	-	-	5.8	11.6	23.2	46.4	84

TABLE A

8	SWLY 25	H	U33	40	5/8G	19.6	34.3	TR	6L	2.6	15.6	7	6	-	0.8	5.0	4.1	29.1	75.5
9	SWLY 22	H & S	P29	182	6/8B	19.6	34.7	TR	6L	-	-	12	6	-	-	-	-	-	91
10	SW 10-22	H A & F	Q27	90	8/8B	19.3	34.7	GN/TR	2N 6L	4.1	-	113	37	-	-	36.6	-	144.8	598.2
11	SW 10-22	H & F	N26	119	8/8B	19.5	34.8	GN/TR	2N 6L	8.2	-	118	68	-	-	22.7	-	107.3	710
12	SW 15	H & F	N26	120	8/8B	19.5	34.8	GN/TR	2N 6L	8.0	-	142	4	-	-	18.3	-	78.2	625
13	SW 10-15	H & S	R22	46	4/8B	19.3	34.5	TR	6L	5.5	-	4	3	-	-	-	-	-	37.7
14	LT-VAR	S F & H	-	VARI	VARI	20.0	35.0	TR	7L	7.0	43.0	38	112	-	3.1	21.4	12.4	85.5	587.3
15	LT-VAR	S F & H	VARI	VARI	VARI	20.0	34.7	GN/TR	2N 6L	6.3	-	77	19	-	-	15.2	-	62.3	393.2
16	LT-VAR	S F & H	VARI	VARI	VARI	19.7	34.8	GN/TR	3N 6L	4.5	-	154	9	-	-	36.2	-	141.4	637.3
17	SW 35-40	H & A	VARI	VARI	VARI	19.7	34.6	-	-	3.5	-	-	-	-	-	-	-	-	-
18	SW 15	H A & F	VARI	VARI	VARI	19.6	35.0	GN/TR	1N 6L	8.0	-	43	40	-	-	10.4	-	41.1	326
19	LT-VAR	A H & F	R25	75	8/8B	20.5	34.7	GN	3N	4.6	13.8	255	-	-	18.5	55.4	66.6	196.6	909
20	NW 12	H & A	VARI	VARI	VARI	19.9	34.9	TR	6L	-	-	17	-	-	-	-	-	-	70
21	NW 17	S H & A	N26	115	7/8B	19.8	34.9	GN/TR	1N 6L	7.5	-	86	6	-	-	-	-	-	357.3
22	SW 25	H & A	R24	-	-	19.7	34.8	-	-	-	Steamed Whakatane to N24 - N28 and return								
23	SW 22	H & A	-	-	-	-	-	-	6L	-	-	? Steamed Whakatane to N24-328 and return							8.2
24	-	-	-	-	-	19.8	34.7	-	-	-	-	-	-	-	-	-	-	-	-
25	LT-VAR	S & H	P24	-	-	-	-	-	6L	-	-	25	Steamed Whakatane to P24 and return						79.5
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	-	S & H	L29	-	-	20.5	35.0	-	6L	-	-	6	14	Steamed Whakatane to L29 & return					104.5
28	LT-VAR	S & H	-	-	-	19.6	34.7	-	6L	-	-	9	-	-	-	-	-	-	31.8
29	LT-VAR	A & H	-	-	-	20.3	34.8	-	-	-	-	-	Steamed Whakatane to 330 and return-						-
30	WLY 5	S & H	-	-	-	19.6	34.8		Steamed Whakatane, Whale Island and Opotiki and return									-	-
31	WLY 10	S H & A	032	-	-	19.5	34.5	-	-	-	Steamed Whakatane to 032 and return						-	-	-
TOTAL																			7'74
AVERAGE						19.8													

TABLE 1 FISHING DATA FROM LOG-BOOK (ALL METHODS AND VESSEL) JANUARY 1970

CH = Chumming
GN = Gill-Netting
TR = Trolling by conventional method
HL = Hand Lining
TR/I = Incidental Trolling
LL = Long-Lining

GENERAL DATA											CATCH								
					NOON						BY NUMBER OF FISH						BY WEIGHT		
Vessel	Day	Area	Depth Metres	Water Colour	Temperature °C	Salinity °/oo	Total Fishing Time Hours	Method	No. Lures-Nets	Hook hrs - Net hrs	Skipjack	Albacore	Yellowfin	Northern Bluefin	Fish per Hook or Net Hour	Fish per hour	Kg per Hook or Net Hour	Kg per Hour	Total Weight Kg
TRADEWIND	2	130 to J29	501	7/8B	23.8	34.9	3.0	TR/1	10	30	-	13	-	-	0.43	4.3	3.37	33.67	101
"	3	J31 to R36	378 to 55	8/8B	23.8	35.0	9.6	TR	10	96	2	32	-	-	0.35	3.5	2.68	26.77	257
"	4	J31 to I31	601 to 501	7/8B	23.9	35.0	11.5	TR	10	115	-	92	-	-	0.80	8.0	6.23	62.17	715
"	9	P29 to J32	914 to 128	8/8B	21.1	34.7	12.0	TR	10	120	2	100	-	-	0.85	8.5	6.51	65.08	781
"	10	J31,J33 to N34	1154 to 251	7/8B	23.0	35.2	10.4	TR	10	104	1	47	-	-	0.47	4.6	3.56	35.58	370
"	11	130/131 J31	927 to 501	7/8B	22.6	35.0	9.5	TR	10	95	-	103	-	-	1.09	10.8	8.42	84.21	800
"	17	T29 to J49	691 to 55	6/8B	22.2	35.0	6.2	TR/1	10	62	20	5	-	-	0.41	4.0	1.98	19.84	123

TABLE 2

JANUARY 1970

"	18	J31 to Q25/P25	525	6/8B	22.6	35.1	8.0	TR/I	10	80	-	6	-	-	0.08	0.8	0.6	5.9	47
"	19	T25	40 to 22	5/8B	21.3	34.7	5.5	TR	10	55	-	7	-	-	0.13	1.3	0.2	1.6	9
TOTALS							75.7	TR TR/I		757	25	405	-	-	0.57	5.7	4.2	42.3	3203
"TRADEWIND"	23	S25	44	5/8B	23.5	34.8	2.8	GN	3	8.4	44	-	1	-	5.36	16.1	20.2	60.7	170
"	27	P29	128	8/8B	23.5	34.7	2.0	GN	1	2.0	374	2	-	-	188	188	786	786	1572
"	28	S25 029	55	5/8B	23.8	35.3	2.0	GN	2	4.0	2	-	-	-	0.5	1	2.0	4.0	8
"	29	T30 S36	54	5/8B	24.6	35.2	3.0	GN	2	6.0	7	-	-	-	1.17	2.3	4.8	9.7	29
TOTAL AND AVERAGES							9.8		8	20.4	427	2	1	-	21.08	44	87.2	181.6	1780
FULL TOTAL					23.1	35.0	85.5				452	407	1	-					4982
WHAKATANE BIG GAME CLUB	23/12 to 28/1	T25 to J31						TR				172	6	13					2296
"EVELYN J"	11	J31 to 131	1154 to 501	-	-	-	6.0	TR	-	-	-	60	-	-	-	10		171	466

TABLE 3

JANUARY 1970

GENERAL DATA											CATCH								
					NOON						BY NUMBER OF FISH						BY WEIGHT		
Vessel	Day	Area	Depth Metres	Water Colour	Temperature °C	Salinity °/oo	Total Fishing Time	Method	No. Lures -Nets	Hook hours Net hours	Skipjack	Albacore	Yellowfin	Northern Bluefin	Fish per Hook or Net Hour	Fish per Hour	Kg per Hook or Net Hour	Kg per Hour	Total Weight Kg
"KIA-ORA"	6	J31 to I31	501	-	-	-	13.0	TR	5	65	-	73	-	-	1.13	5.6	8.7	43.6	567
"	7	J31 K31	501	-	-	-	18.0	TR	5	90	-	8	-	-	0.09	0.4	0.7	3.4	62
"	9	J31	506	-	-	-	4.5	TR	7	31.5	-	42	-	-	1.34	9.3	10.3	72.4	326
"	10	J31 I33	506	-	-	-	12.5	TR	7	87.5	-	75	1	-	0.87	6.0	7.1	49.6	620
"	11	J31	506	-	-	-	3.0	TR	7	21.0	-	5	-	-	0.24	1.6	1.9	13.0	39
TOTALS AND AVERAGES			-	-	-	-	51.0	-	-	295	-	203	1	-	0.70	4.0	5.5	31.7	1615
"TAKAPU"	11	034	-	-	-	-	7.0	TR	-	-	-	15	-	-	-	2.1	-	16.7	117
"	18	L27	-	-	-	-	6.0	TR	-	-	2	4	-	1	-	1.2	-	10.3	62
TOTAL			-	-	-	-	13.0	-	-	-	2	19	-	1	-	1.7	-	13.8	180

TABLE 4

JANUARY 1970

"STRANGER"	6	J31	501	-	-	-	10.0	TR	7	70	-	55	-	-	0.79	5.5	6.1	42.8	428
"	7	J31	-	-	-	-	6.0	TR	8	48	-	12	-	-	0.25	2.0	1.9	15.5	93
"	9	J30/31 I30/31	-	-	-	-	14.0	TR	8	112	5	95	-	-	0.90	7.1	6.8	54.3	760
"	10	J30/31	-	-	-	-	3.1	TR	7	21.7	-	41	-	-	1.89	13.2	14.7	102.9	319
TOTALS			-	-	-	-	33.1		-	251.7	5	203	-	-	0.83	6.3	6.4	48.3	1599
"VIKING"	No Log Sheet										13	47							420

TABLE 5

FEBRUARY 1970

GENERAL DATA											CATCH								
					NOON						BY NUMBER OF FISH						BY WEIGHT		
Vessel	Day	Area	Depth Metres	Water Colour	Temperature °C	Salinity °/oo	Total Fishing Time Hours	Method	No.Lures - Nets	Hook Hours Net Hours	Skipjack	Albacore	Yellowfin	Northern Bluefin	Fish per Hook or Net Hour	Fish per Hour	Kg per Hook or Net Hour	Kg per Hour	Total Weight Kg
"STRANGER"	8	S26	73	6/8B	23.5	34.8	3.0	GN	3	9	78	-	-	-	8.67	26	34.3	103	309
"	11	S to P25	91		22.7	35.2	7.0	TR	5	35	23	-	-	-	0.66	3.3	2.6	13.0	91
"	12	S25-029	73-183	7/8B	22.7	34.8	2.5	GN/TR	3	7.5	84	9	-	1	12.54	33.6	44.3	132.8	332
"	13	R20	42	6/8B	21.8	34.8	1.5	G/N/TR	1	1.5	25	2	-	-	18.0	16.7	66	66	99
"	18	R24	44	5/8B			1.08	G/N	2	2.16	9	-	-	-	4.17	8.3	16.2	32.4	35
"	25	R27	95	5/8B	23.3	35.5	1.17	G/N	1	1.17	19	-	-	-	16.27	16.2	64.1	64.1	75
TOTAL					22.8	35.0	16.25		15	56.33	238	11		1	4.44				941
"EVELYN J"	5	T26	38	-	-	-	3.00	G/N	5	15.0	154	-	-	-	10.27	51.3	40.6	203	609
"	17	S26	73	-	-	-	4.0	G/N	4	16.0	60	-	-	-	3.75	15.0	14.8	59.3	237
"	21	S26	73	-	-	-	1.5	G/N	1	1.5	56	-	-	-	37.34	37.3	147.3	147.3	221
TOTAL			-	-	-	-	8.5		10	32.5	270	-	-	-	8.31	31.8	32.9	125.6	1068

TABLE 6

FEBURARY 1970

"KIA-ORA"	5	T26	38	-	-	-	4.6	G/N	6	27.6	97	-	-	-	3.52	21.1	13.9	83.5	384
"	6	T26	38	-	-	-	3.5	G/N	5	17.5	106	-	-	-	6.06	30.3	23.9	119.7	419
"	7	T26	38	-	-	-	5.25	G/N	7	36.75	210	-	-	-	5.72	40.0	22.6	158.1	830
"	8	T26	38	-	-	-	5.6	G/N	4	22.4	146	-	-	-	6.52	26.1	25.8	103.0	577
SUB-TOTAL			-	-	-	-	18.95		22	104.25	559 594	-	-	-	5.37	29.5	21.2	116.6	2210 2348
TOTAL			-	-	-	-	-		-	-	1153	-	-	-	-	-	-	-	4558
		An extra 2348 kg was registered for "KIA-ORA" at the shed, but the extra 594 fish to substantiate this weight is <u>not</u> shown on Log Sheet																	
"TAKAPU"	6	U28	37	-	-	-	-	G/N	6	-	92	-	-	-	-	-	-	-	364
"	7	U28	37	-	-	-	-	G/N	6	-	107	-	-	-	-	-	-	-	425
"	8	U28	27	-	-	-	5.1	G/N	6	30.6	56	-	-	-	1.83	11.0	7.2	43.3	221
SUB-TOTAL			- -	- -	- -	-	-		17	-	255 605	-	-	-	-	-	-	-	1010 2392
TOTAL			-	-	-	-	-		-	-	860	-	-	-	-	-	-	-	3401 T
		An extra 2392 kg was registered for "TAKAPU" at the shed but the extra 605 fish to substantiate this weight is <u>not</u> shown on Log Sheet																	

TABLE 7

FEBRUARY 1970

GENERAL DATA											CATCH								
					NOON						BY NUM OF FISH						BY WEIGHT		
Vessel	Day	Area	Depth Metres	Water colour	Temperature °C	Salinity °/oo	Total Fishing Time Hours	Method	No. of Lures - Nets	Hook hours Net hours	Skipjack	Albacore	Yellowfin	Northern Bluefin	Fish per Hook or Net Hour	Fish per Hour	Kg per Hook or Net Hour	Kg per Hour	Total Weight Kg
"ATATU"	8	S26 T26	51	-	-	-	3.75	GN/TR	5	18.75	256	-	-	-	13.66	68.3	54	269.9	1012
"	11	R25 T25	64	-	-	-	4.65	TR	8	37.2	147	-	-	-	3.96	31.6	15.6	124.9	581
"	12	T26	38	-	-	-	0.5	GN	1	0.5	22	-	-	-	44.0	44.0	174	174	87
"	15	R28	73	-	-	-	.5	GN	1	0.5	15	-	-	-	10.0	10.0	40	40	60
"	16	R27 S27	82	-	-	-	3.85	GN	3	11.6	247	-	-	-	21.3	64.2	84.2	253.8	977
"	17	R26	91	-	-	-	0.75	GN	1	0.75	52	-	-	-	69.34	69	273	273	205
"	21	R29	42	-	-	-	0.75	GN	2	1.5	5	-	-	-	3.34	6.6	13.3	26.7	20
"	24	S27 T26	59	-	-	-	1.0	GN	2	2.0	5	-	-	-	2.5	5.0	10	20	20
"	25	R30	73	-	-	-	0.5	GN	1	0.5	17	-	-	-	34	34	134	134	67
"	27	U29	42	-	-	-	0.5	GN	1	0.5	55	-	-	-	110	110	436	436	218
SUB-TOTAL No Date			-	-	-	-	17.75		25	74.8	821 140	-	-	-	10.98	46	45.0	189.8	3369 555
TOTAL			-	-	-	-	-		-	-	961	-	-	-	-	-	-	-	3803

TABLE 8

FEBRUARY 1970

"VIKING"	4	S26	T28	-	-	-	-	-	TR	-	-	6	1	12	-	-	-	-	-	79
"	5	T27	T28	-	-	-	-	-	G/N	-	-	160	-	2	-	-	-	-	-	639
"	6	T27		-	-	-	-	-	G/N	-	-	64	-	-	-	-	-	-	-	253
"	7	U29		-	-	-	-	6.2	G/N	8	49.6	185	-	-	-	3.73	30	14.8	118.1	732
"	8	U27	S25	-	-	-	-	4.0	G/N	5	20.0	149	-	-	-	7.45	37.3	29.5	147.3	589
"	16	R26		-	-	-	-	0.9	G/N	1	0.9	49	-	-	-	54.54	54	215.6	215.6	194
"	17	S26		-	-	-	-	4.0	G/N	2	8.0	218	-	-	-	27.25	54.5	107.8	215.5	862
"	21	S29		-	-	-	-	-	G/N	2	-	116	-	-	-	-	-	-	-	459
"	22	R25		-	-	-	-	1.25	G/N	1	1.25	22	-	-	-	17.6	17.6	69.6	69.6	87
"	27	R25	R26	-	-	-	-	1.8	G/N	1	1.8	72	-	-	-	40.0	40.0	158.3	183.3	285
"	28	R26		-	-	-	-	-	TR	-	-	8	-	-	-	-	-	-	-	32
TOTAL FOR GILL NETTING				-	-	-	-	18.15	G/N	18	81.5	695	-	-	-	8.53	38.2	33.7	151.4	2748
TOTAL FOR GILL NETTING AND TROLLING				-	-	-	-	-	G/N TR	-	-	1049	1	14	-	-	-	-	-	4210
NO DATE				-	-	-	-	-		-	-	61	-	-	-	-	-	-	-	240
FULL TOTAL				-	-	-	-	-		-	-	1110	1	14	-	-	-	-	-	4450
"COMRADE"	3	T26		-	-	-	-	1.0	TR	2	2	-	15	-	-	7.5	15	17	34	34

TABLE 9

FEBRUARY 1970

GENERAL DATA											CATCH								
					NOON						BY NUMBER OF FISH						BY WEIGHT		
Vessel	Day	Area	Depth Metres	Water Colour	Temperature °C	Salinity °/oo	Total Fishing Time Hours	Method	Number of Lures - Nets	Hook Hours Net Hours	Skipjack	Albacore	Yellowfin	Northern Bluefin	Fish per Hook or Net Hour	Fish per hour	kg per Hook or net hour	kg per hour	Total Weight kg
"DIANA"	6	T27	-	-	-	-	1.67	G/N	3	5.0	58	-	-	-	11.6	34.7	46	137.7	230
"	7	U29	-	-	-	-	4.2	G/N	6	25.2	238	-	-	-	9.45	59	38.9	233.6	981
"	8	U27 S25	-	-	-	-	2.2	G/N	2	4.4	180	-	-	-	40.9	81.8	161.8	323.6	712
"	11	S25	-	-	-	-	1.4	G/N	2	2.8	29	-	-	-	10.36	20.7	41.4	82.1	115
"	12	S25	-	-	-	-	1.5	G/N	1	1.5	61	-	-	-	40.67	40.6	160.7	160.7	241
"	15	R28	-	-	-	-	2.4	G/N	3	7.2	95	-	-	-	13.2	39.6	52.2	156.7	376
"	16	R27 S37	-	-	-	-	3.67	G/N	4	14.7	120	-	-	-	8.17	32.7	32.3	129.4	475
"	17	R26	-	-	-	-	1.0	G/N	1	1.0	9	-	-	-	9.0	9.0	35.0	35.0	35
"	18	R26	-	-	-	-	0.75	G/N	1	0.75	-	-	-	-	-	-	-	-	-
"	19	S29	-	-	-	-	0.8	G/N	1	0.8	11	-	-	-	13.75	13.75	55.0	55.0	44
"	21	S29	-	-	-	-	1.35	G/N	2	2.7	51	-	-	-	18.89	37.7	74.8	149.6	202
"	22	R25	-	-	-	-	1.35	G/N	2	2.7	12	-	-	-	4.45	8.8	17.4	34.8	47
"	27	V29	-	-	-	-	1.25	G/N	1	1.25	76	-	-	-	60.8	60.8	240	240	300
SUB-TOTAL			-	-	-	-	23.5		29	70.0	950	-	-	-	13.6	40.4	53.7	159.9	3757

TABLE 10

February 1970

"DIANA" SUB-TOTAL NO DATE			-	-	-	-	23.5		29	70.0	950	-	- 6	-	13.6	40.4	53.7	159.9	3757 40
FULL TOTAL											950		6						3797
"PINTATL"	6	U27 U28	-	-	-	-	3.75	G/N	7	26.25	65	-	-	-	2.5	17.3	9.8	68.5	257
"	7	R23	-	-	-	-	1.3	G/N	1	1.3	18	-	-	-	13.8	13.8	54.6	54.6	71
"	8	U26 R23	-	-	-	-	4.7	G/N	7	32.9	144	-	-	-	4.4	30.6	17.3	121.3	570
"	11	U26 T27 S25	-	-	-	-	5.6	G/N	8	44.8	144	-	-	-	3.2	25.7	12.7	101.8	570
"	12	T25 S24 R22	-	-	-	-	3.6	G/N	4	14.0	32	-	-	-	2.3	9.1	9.0	36.0	126
SUB-TOTAL NO DATE			-	-	-	-	18.85		27	119.25	403 28	-	-	-	3.4	21.4	13.4	84.6	1594 109
TOTAL											431								1702

TABLE 11

FEBRUARY 1970

GENERAL DATA											CATCH								
					NOON						BY NUMBER OF FISH						BY WEIGHT		
Vessel	Day	Area	Depth Metres	Water Colour	Temperature °C	Salinity °/oo	Total Fishing Time Hours	Method	Number of Lures - Nets	Hook Hours Net Hours	Skipjack	Albacore	Yellowfin	Northern Bluefin	Fish per Hook or Net Hour	Fish per hour	Kg per Hook or Net Hour	Kg per Hour	Total Weight Kg
"HEATHER"	6	-	-	-	-	-		G/N	-	-	132	-	-	-	-	-	-	-	528
"	7	U29	-	-	-	-	5.3	G/N	6	31.8	146	-	-	-	4.6	27.5	18.4	110.2	584
"	8	U29	-	-	-	-	5.0	G/N	9	45.0	143	-	-	-	3.2	28.6	12.7	114.4	527
"	15	R26 025	-	-	-	-	2.25	G/N	4	9.0	60	-	-	-	6.6	26.6	26.7	106.7	240
"	21	T29	-	-	-	-	0.95	G/N	3	2.85	13	-	-	-	4.57	4.3	18.2	54.7	52
"	22	T29	-	-	-	-	1.3	G/N	2	2.6	50	-	-	-	19.2	38.5	76.9	153.8	200
"	24	S27	-	-	-	-		TR			8	3							52
NO DATE								G/N			203								812
NO DATE								TR				16							107
TOTAL											755	19							3147

TABLE 12

FEBRUARY 1970

"DEFIANT"	NO DATE									156								617
WHAKATANE BIG GAME CLUB											8	12	9					

TABLE 13

MARCH 1970

GENERAL DATA											CATCH								
					NOON						BY NUMBER OF FISH						BY WEIGHT		
Vessel	Day	Area	Depth Metres	Water Colour	Temperature °C	Salinity °/oo	Total Fishing Time Hours	Method	No. of Lures-Nets	Hook Hours Net Hours	Skipjack	Albacore	Yellowfin	Northern Bluefin	Fish per Hook or Net Hour	Fish per hour	Kg per Hook or Net Hour	Kg per hour	Total Weight kg
"STRANGER"	2	V30	31	-	22.4	35.2	1.0	GN/TR	2	2	9	-	1 TR	-	4.5	9	15.0	30.0	30
"	3	Q31	91	-	22.3	35.0	1.5	GN	3	4.5	65	-	-	-	14.4	43.3	48.7	146	219
"	4	T29	55	-	22.0	35.1	5.4	GN	4	21.6	48	-	-	-	2.2	8.9	7.5	29.8	161
"	5	U28	37	7/8B	21.9	34.8	5.2	GN & 23 Pole/ Line	4	20.8	209	-	-	-	10.0	40.2	33.8	135.2	703
"	10	R26	86	-	23.1	34.8	-	TR	-	-	27	5	1 41 cms	-	10.0	-	-	-	108
"	11	S25 P28	54	-	22.8	35.0	-	TR	-	-	15	2	-	-	-	-	-	-	57
"	12	Q25	91	-	22.3	35.0	-	TR	-	-	18	5	5	-	-	-	-	-	94
"	13	R27	95	-	22.0	35.0	-	TR	-	-	13	3	-	-	-	-	-	-	54
"	16	T29 M45	-	-	22.4	34.9	-	TR	-	-	3	-	-	-	-	-	-	-	10
"	17	T29 M45	-	-	21.4	35.0	-	TR	-	-	20	5	-	-	-	-	-	-	84
"	18	Q39 S34	91	-	20.3	35.0	-	TR	-	-	-	3	-	-	-	-	-	-	10
"	19	-	-	-	-	-	-	TR	-	-	3	11	-	-	-	-	-	-	47

TABLE 14

MARCH 1970

"STRANGER	20	-	-	-	-	-	-	TR	-	-	16	5	-	-	-	-	-	-	70
"	23	S25	54	5/8G	21.1	34.8	4.2	GN	2	8.4	167	-	-	-	20	40	66.9	133.8	562
"	24	S25 T27	53	6/8B	21.3	34.7	5.0	TR	5 lures	25.0	66	-	-	-	2.64	13.2	8.9	44.4	222
"	24	S25	54	8/8B	20.9	34.7	2.8	GN	2	5.6	152	-	-	-	27.15	54	91.3	182.5	511
"	25	R26 027	104	5/8G	21.0	35.0	3.0	TR	4	12.0	17	1	-	-	1.5	6	5.0	20.0	60
"	31	Q25	86	6/8B	21.2	34.9	3.5	TR	5	17.5	53	4	-	-	3.3	16.3	11.0	34.6	192
TROLLING								TR			251	44	7	-					1009
GILL-NET							20.1	GN	17	62.9	650				10.3	32.3	35.1	109.8	2207
TOTAL					21.8	35.0					901	44	7						3215
"EVELYN J"	3	S25	-	-	-	-	2.5	GN	2	5.0	63	-	-	-	12.6	25.2	45.2	90.4	226
"	5	T27 T28	-	-	-	-	6.0	GN	5	30.0	263	-	-	-	8.8	43.8	31.5	157.5	945
SUB-TOTAL							8.5	GN	7	35.0	326	-	-	-	9.3	38.3	33.5	137.8	1171
											28								100
TOTAL											354								1271

An extra 100 kg was registered for "Evelyn J" at the sheds but the extra 28 fish to substantiate this weight is not shown on Log Sheet

TABLE 15

MARCH 1970

GENERAL DATA											CATCH								
					NOON						BY NUMBER OF FISH							BY WEIGHT	
Vessel	Day	Area	Depth	Water Colour	Temperature °C	Salinity °/oo	Total Fishing Time	Method	No.of Lures-Nets	Hook Hours Net Hours	Skipjack	Albacore	Yellowfin	Northern Bluefin	Fish per Hook or Net Hour	Fish per hour	Kg per Hook or Net Hour	Kg per hour	Total Weight kg
"KIA-ORA"											61	1	1						226
TOTAL											61	1	1						226
The figure of 226 kg was registered for "Kia-ora" at the sheds but the extra 63 fish to substantiate this weight is not shown on Log Sheet																			
"TAKAPU"											107								384
TOTAL											107								384
The figure of 384 kg was registered for "Takapu" at the sheds but the extra 107 fish to substantiate this weight is not shown on Log Sheet																			
"PINTAIL" NO DATE											206								684
TOTAL											206								684

TABLE 17

MARCH 1970

GENERAL DATA											CATCH								
					NOON						BY NUMBER OF FISH							BY WEIGHT	
Vessel	Day	Area	Depth Metres	Water Colour	Temperature °C	Salinity °/oo	Total Fishing Time Hours	Method	No. of Lures-Nets	Hook Hours Net Hours	Skipjack	Albacore	Yellowfin	Northern Bluefin	Fish per Hook or net hour	Fish per hour	Kg per hour or Net hour	Kg per hour	Total Weight kg
"HEATHER"	2	T25	-	-	-	-	0.5	GN TR	-	0.5	31	-	4	-	70	70	226	226	113
"	3	Q27	-	-	-	-	9.0	TR	3	27	12	-	2	-	0.5	1.5	1.7	5.0	45
"	3	Q27	-	-	-	-	1.0	GN	1	1.0	30	-	-	-	30	30	97	97	97
"	4	T29	-	-	-	-	4.2	GN	3	12.6	64	-	7	-	5.6	16.9	18.2	54.5	229
"	5	T29	-	-	-	-	4.2	GN	5	21.0	177	-	-	-	8.4	42.1	27.2	136	571
"	6	R27	-	-	-	-	-	GN TR	-	-	32	-	7	-	-	-	-	-	126
"	9		-	-	-	-		TR	-	-	15	-	-	-	-	-	-	-	49
"	10	T26 L31	-	-	-	-	9.0	TR	-	-	25	10	-	-	-	-	-	-	113
"	12	T26 T28	-	-	-	-	3.0	TR	-	-	4	6	-	-	-	-	-	-	32
"	17		-	-	-	-	-	GN TR	-	-	17	1	2	-	-	-	-	-	61
"	18		-	-	-	-	-	TR	-	-	1	-	-	-	-	-	-	-	4
"	20		-	-	-	-	-	GN TR	-	-	4	2	-	-	-	-	-	-	20
"	21	Q27	-	-	-	-	-	TR	-	-	6	1	-	-	-	-	-	-	23
"	22	T26	-	-	-	-	1.25	GN	2	2.5	56	-	-	-	22.4	44.8	72.4	144.8	181
"	23	R25	-	-	-	-	7.0		4	28.0	182	3	-	-	6.6	26.4	21.3	85.3	597

TABLE 16

MARCH 1970

"ATATU"	2	R29	-	-	-	-	1.0	GN	1	1.0	16	-	-	-	16	16	57	57	57
"	3	R29	-	-	-	-	1.0	GN TR	1	1.0	1	-	-	-	1.0	7.9	4	4	4
"	5	T27 U 27	-	-	-	-	1.9	GN TR	3	5.7	47	-	2TR	-	8.6	25.8	30.9	92.6	176
"	6	U27	-	-	-	-	0.4	GN TR	1	0.4	10	-	1TR	-	27.5	25.0	100	100	40
"	17	V27	-	-	-	-	1.75	GN	2	3.5	8	-	-	-	2.3	4.6	8.3	16.6	29
"	20	R29	-	-	-	-		TR	-	-	35	16	-	-	-	-	-	-	183
"	21	S25 S26	-	-	-	-	-	TR	-	-	50	5	-	-	-	-	-	-	198
"	22	S25	-	-	-	-	0.75	GN	1	0.75	8	-	-	-	10.67	10.6	38.7	38.7	29
"	*24	R25 T25	-	-	-	-		TR	-	-	86	6	-	-	-	-	-	-	330
"	*24	R25	-	-	-	-	1.8	GN	1	1.8	263	-	-	-	146.12	146	524	524	944
"	28	R25	-	-	-	-	-	TR	-	-	14	-	-	-	-	-	-	-	50
"	29	U28	-	-	-	-	-	TR	-	-	14	-	-	-	-	-	-	-	50
"	30	S24	-	-	-	-	-	TR	-	-	24	-	-	-	-	-	-	-	86
TROLLING GILL-NET								TR GN			223 356	27	3						899 1278
TOTAL											579	27	3						2176
*TOTAL FOR 24											349								1275
WAIHOU BAY								TR			405								1364
WHAKATANE BIG GAME CLUB											83								267

TABLE 18

MARCH 1970

"	24	T25	-	-	-	-	2.3	GN	2	4.6	84	-	-	-	18.3	36.5	58.9	112.6	271
"	24	T25	-	-	-	-	2.0	TR	2	4.0	34	-	-	-	8.5	.7.0	27.5	60.4	110
"	29	U28	-	-	-	-		TR	2	-	22	-	-	-	-	-	-	-	71
"	29	U28	-	-	-	-	1.2	GN	1	1.2	30	-	-	-	25	25	80.8	80.8	97
"	30	U28	-	-	-	-	8.0	TR	2	16.0	38	-	1	-	2.44	4.8	7.7	15.4	123
"	30	U28	-	-	-	-	3.5	GN	4	14.0	66	-	-	-	4.7	18.9	15.2	60.9	213
"	31	U28	-	-	-	-	3.0	TR	2	6.0	12	-	-	-	2.0	4.3	7.0	14.0	42
"	31	U28	-	-	-	-	1.25	GN	1	1.25	26	-	-	-	20.8	20.8	67.2	67.2	84
TROLLING EXTRAS							22	TR	9	53.0	96 73	 17	3		1.87	4.5	6.0	14.5	319 291
SUB-TOTAL											169	17	4						610
GILL-NET EXTRAS							26.4	GN	24	86.7	746 53	3 3	11 9		8.8	28.8	29.4	96.4	2545 207
SUB-TOTAL											799	6	20						2660
NO DATE											69	7							235
FULL TOTAL											1037	30	24						3506

TABLE 19

MARCH 1970

GENERAL DATA											CATCH								
					NOON						BY NUMBER OF FISH							BY WEIGHT	
Vessel	Day	Area	Depth Metres	Water Colour	Temperature °C	Salinity °/oo	Total Fishing Time Hours	Method	No. of Lures-Nets	Hook Hours Net Hours	Skipjack	Albacore	Yellowfin	Northern Bluefin	Fish per Hook or net Hour	Fish per hour	Kg per Hour or Net Hour	Kg per Hour	Total Weight Kg
"COMRADE"	6	T28	-	-	-	-	5.0	GN CH HL	1	5.0	167	-	-	-	33.4	33.4	120	120	600
"	23		-	-	-	-	-	TR HL	-	-	20	-	-	-	-	-	-	-	72
"	24	P26	-	-	-	-	2.0	GN	1	2.0	85	-	-	-	42.5	42.5	152.5	152.5	305
GILL-NET TROLLING							7.0	GN TR	2	14.0	252 20	-	-	-	18.0	36.0	129.3	129.3	905 72
SUB-TOTAL NO DATE											272 93								977 335
TOTAL											365								1312
"VIKING"	2	S28	-	-	-	-	6.0	TR	2	12.0	18	-	-	-	1.5	3.0	6.3	12.5	75
"	4	S28	-	-	-	-	-	GN TR	-	-	72	-	5	-	-	-	-	-	311
"	5	S28	-	-	-	-	2.25	GN	1	2.25	150	-	-	-	66.6	66.6	275.6	275.6	620

TABLE 20

MARCH 1970

"VIKING" Continued	6	-	-	-	-	-	-	GN	-	-	-	-	-	-	-	-	-	-	33
"	17	V27	-	-	-	-	4.0	TR	2	8.0	10	2	3	-	1.9	3.75	15.6	27.3	109
"	23	R29	-	-	-	-	3.0	GN	2	6.0	176	-	-	-	29.3	58.6	121.3	242.7	728
"	24	R25	-	-	-	-	5.0	GN	2	10.0	90	-	-	-	9.0	18.0	37.2	74.4	372
TROLLING							10.0	TR	4	20.0	28	2	3	-	1.65	3.3	9.2	18.4	184
GILL-NET							10.25	GN	5	18.25	416	-	-	-	22.8	40.6	94.3	167.9	1721
EXTRAS NO DATE											80	-	5	-					344
TOTAL											496	2	8						2249
"DIANA"	3	S29	-	-	-	-	0.6	GN	1	0.6	31	-	-	-	51.7	51.7	168.3	168.3	101
"	4	S29	-	-	-	-	0.8	GN	2	1.6	11	-	-	-	6.9	13.8	22.5	45	36
"	5	S29 T29	-	-	-	-	3.5	GN	4	14.0	230	-	-	-	16.4	65.7	53.8	215.1	753
"	16	S26	-	-	-	-	2.6	GN TR	2	5.2	118	(7TR)	-	-	23.66	45.4	76.2	152.3	396
"	20	S26	-	-	-	-	-	TR	-	-	2	-	-	-	-	-	-	-	6.0
"	23	R25	-	-	-	-	4.3	GN	5	21.5	163	-	1	-	7.6	38	24.8	124.2	534
"	24	P25	-	-	-	-	-	TR	-	-	-	3	-	-	-	-	-	-	5.0
"	28	U26	-	-	-	-	1.4	GN	2	2.8	42	-	-	-	15	30	48.9	91.9	137
"	30	U28	-	-	-	-	-	TR	-	-	2	-	-	-	-	-	-	-	6.0
TROLLING								TR			4	10	1						29
GILL-NET							13.2	GN	16	45.7	595	-	-	-	13	45	42.6	147.4	1946
EXTRAS NO DATE											8								24
TOTAL											607	10	1						1998

TABLE 21

APRIL 1970

GENERAL DATA											CATCH								
					NOON						BY NUMBER OF FISH							BY WEIGHT	
Vessel	Day	Area	Depth metres	Water Colour	Temparature °C	Salinity °/oo	Total Fishing Time hours	Method	No. of Lures-Nets	Hook Hours Net Hours	Skipjack	Albacore	Yellowfin	Northern Bluefin	Fish per Hook or Net Hour	Fish per Hour	Kg per hour or Net hour	Kg per Hour	Total Weight kg
"STRANGER"	7	R26	90	-	-	-	1.0	GN	1	1.0	25	-	-	-	25	25	89	89	89
"	7	R25 R27	86	5/8G	21.7	34.7	5.0	TR	5	25.0	276	-	5	-	11.24	60.2	42.7	213.4	1067
"	8	R25 R27	86	5/8G	20.0	34.8	8.0	TR	5	40	134	-	-	-	3.35	16.8	11.9	59.4	475
TOTAL											435		5						1631
"COMRADE"	6-8	R25 R27	-	-	-	-	-	HL CH	-	-	128	-	-	-	-	-	-	-	618
"	13	024	-	-	-	-	1.0	HL CH	2	2.0	180	1	16	-	98.5	197	389	778	778
"	21 to 24		-	-	-	-	-	GN	-	-	194	-	-	-	-	-	-	-	785
TOTAL											502	1	16						2081
"SEA-HUNTER"	NO DATES										135								455

TABLE 22

APRIL 1970

"HEATHER"	1	T29	-	-	-	-	4.3	GN	2	8.6	56	-	-	-	6.5	13.0	21.8	43.7	188
"	6		-	-	-	-	-	GN TR	-	-	6	-	-	-	-	-	-	-	20
"	7	T29	-	-	-	-	6	TR	3	18	64	-	5	-	3.84	10.7	11.9	35.8	215
"	7	T26	-	-	-	-	1.0	GN	1	1.0	25	-	-	-	25	25	84	84	84
"	8	T25	-	-	-	-	8.0	TR	2	16.0	60	-	1	-	3.8	7.6	12.8	25.6	205
"	12	P25	-	-	-	-	2.3	GN	1	2.3	97	-	-	-	42.2	42.2	141.7	141.7	326
"	13	024	-	-	-	-	6.5	TR	2	13.0	31	-	-	-	2.4	4.8	8.0	16	104
"	14	T28	-	-	-	-	-	TR	-	-	3	-	-	-	-	-	-	-	10
"	15	U30	-	-	-	-	1.0	GN	1	1.0	23	-	-	-	23	23	77	77	77
"	16	U30	-	-	-	-	-	GN	-	-	1	-	-	-	-	-	-	-	3
"	17	T23	-	-	-	-	2.3	GN	2	4.6	16	-	-	-	3.5	7.0	11.7	23.5	54
"	18	Q27	-	-	-	-	1.25	GN	1	1.25	42	-	-	-	33.6	33.36	112.8	112.8	141
"	19		-	-	-	-	-	GN TR	-	-	19	-	-	-	-	-	-	-	64
"	20	T28 T29	-	-	-	-	6.0	TR	2	12.0	51	-	-	-	4.25	8.5	14.2	28.5	171
"	21	T23	-	-	-	-	8.5	TR	3	25.5	24	-	-	-	0.95	2.8	3.2	9.6	82
"	22	T23	-	-	-	-	2.25	GN TR	2	4.5	87	-	-	-	19.3	38.6	65.1	130.2	293
"	23	T23 R25	-	-	-	-	8.5	TR	2	17.0	46	-	-	-	2.7	5.4	9.7	18.2	155
"	24		-	-	-	-	-	GN/TR	-	-	17	-	3	-	-	-	-	-	67
"	25	R26	-	-	-	-	2.2	GN	1	2.2	100	-	-	-	45.5	45.5	152.7	152.7	336
"	28		-	-	-	-	-	TR	-	-	5	-	-	-	-	-	-	-	17
TROLLING											284		6						958
GILL-Net											489		3						1654
TOTAL											773		9						2612

TABLE 23

APRIL 1970

GENERAL DATA											CATCH								
					NOON						BY NUMBER OF FISH							BY WEIGHT	
Vessel	Day	Area	Depth Metres	Water Colour	Temperature °C	Salinity °/oo	Total Fishing Time hours	Method	No. of Lures-Nets	Hook Hours Net Hours	Skipjack	Albacore	Yellowfin	Northern Bluefin	Fish per Hook or Net Hour	Fish per Hour	Kg per Hour or Net Hour	Kg per Hour	Total Weight kg
"VIKING"	6	U28	-	-	-	-	2.4	GN	2	4.8	28	-	-	-	5.8	11.6	21.5	42.9	103
"	7	U28	-	-	-	-	8.0	TR	2	16.0	13	-	-	-	0.82	1.6	3.0	6.0	48
"	12	R26	-	-	-	-	1.5	GN	1	1.5	105	-	-	-	70	70	258	258	387
"	13-14	U28 U27	-	-	-	-	-	TR	-	-	60	-	-	-	-	-	-	-	221
"	15	U27	-	-	-	-	2.0	GN	1	2.0	63	-	-	-	31.5	31.5	116	116	232
"	18		-	-	-	-	-	TR	-	-	21	-	-	-	-	-	-	-	77
"	19	U25	-	-	-	-	-	GN	-	-	6	-	-	-	-	-	-	-	22
"	20	W27	-	-	-	-	-	TR	-	-	31	-	-	-	-	-	-	-	114
"	21-22	U28	-	-	-	-	-	TR	-	-	25	-	-	-	-	-	-	-	92
"	23	R25	-	-	-	-	-	GN	-	-	141	-	-	-	-	-	-	-	519
"	25	R25	-	-	-	-	-	GN TR	-	-	26	-	1	-	-	-	-	-	100
TOTAL											519		1						1915

TABLE 24

APRIL 1970

"DIANA"	12	T24	-	-	-	-	1.25	GN	3	3.75	20	-	-	-	5.3	16.0	19.7	59	74
"	13	T23 T25	-	-	-	-	0.5	GN	1	0.5	18	-	-	-	36.0	36.0	132	132	66
"	14	U27	-	-	-	-	0.5	GN	1	0.5	17	-	-	-	34.0	34.0	126	126	63
"	15	U27 U28	-	-	-	-	2.6	GN	3	7.8	34	-	-	-	4.4	13.1	16	48.1	125
"	17	T24	-	-	-	-	1.0	GN	2	2.0	14	-	-	-	7.0	7.0	25.5	51	51
"	18	T26	-	-	-	-	-	TR	-	-	4	-	-	-	-	-	-	-	15
"	21	U26 T22	-	-	-	-	-	GN TR	-	-	26	-	-	-	-	-	-	-	96
"	22	U24	-	-	-	-	6.1	GN	8	48.8	98	-	-	-	2.0	16.1	7.4	59.2	361
"	23	V25 S24	-	-	-	-	-	GN TR	-	-	36	-	-	-	-	-	-	-	133
"	24	T26	-	-	-	-	-	GN TR	-	-	3	-	-	-	-	-	-	-	11
"	25	R25	-	-	-	-	-	GN TR	-	-	6	-	-	-	-	-	-	-	22
TOTAL											276								1016
"EVELYN J"	NO DATES							GN			168								565
"HEATHER"											1							MAY 1970	4
"TAKAPU"	28	P26									6						DECEMBER 1969		33
WHAKATANE BIG GAME CLUB	23											1							63